



AERONAUTICAL ENGINEERING

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WITH INDEXES

Supplement 54

FEBRUARY 1975

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ACCESSION NUMBER RANGES

Accession numbers cited in this Supplement fall within the following ranges:

STAR (N-10000 Series) N75-10001—N75-11891

IAA (A-10000 Series) A75-10001—A75-13150

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 54

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in January 1975 in

- *Scientific and Technical Aerospace Reports (STAR)*
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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971. Since that time, monthly supplements have been issued.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 316 reports, journal articles, and other documents originally announced in January 1975 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

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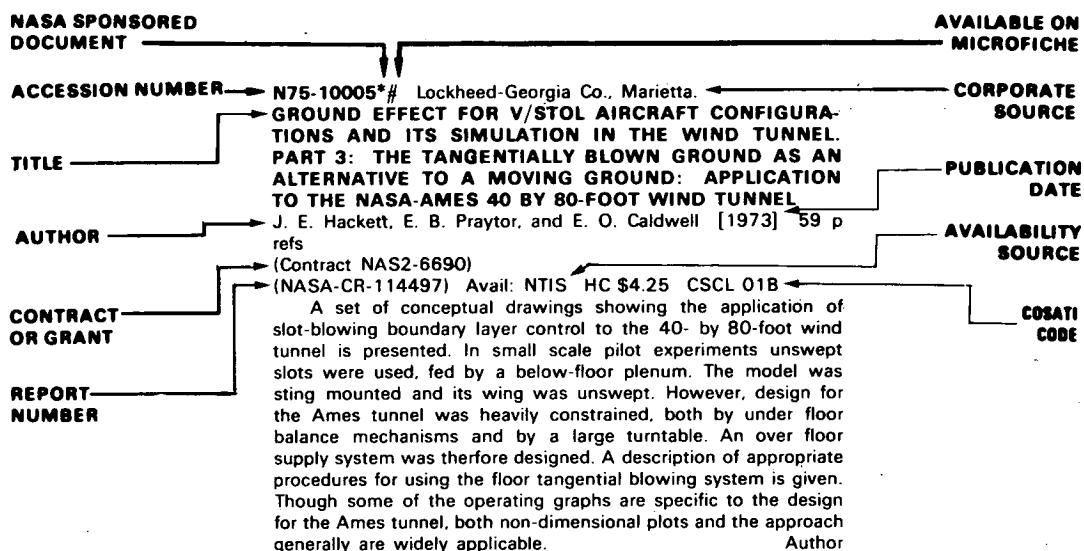
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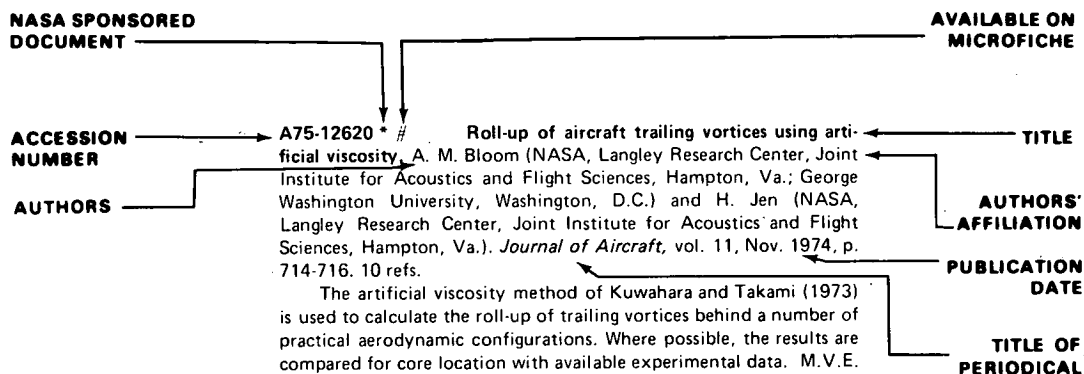
TABLE OF CONTENTS

	Page
IAA Entries	1
STAR Entries	23
Subject Index	A-1
Personal Author Index	B-1
Contract Number Index	C-1

TYPICAL CITATION AND ABSTRACT FROM STAR



TYPICAL CITATION AND ABSTRACT FROM IAA



AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 54) FEBRUARY 1975



IAA ENTRIES

A75-10017 YF-16 could advance air combat tactics. D. E. Fink. *Aviation Week and Space Technology*, vol. 101, Oct. 21, 1974, p. 40-44.

Discussion of new levels of maneuverability, important to air combat, in the YF-16 aircraft. Two YF-16 lightweight fighter prototypes designed with advanced features including a high thrust-to-weight ratio, relaxed static stability, low wing loading and a fly-by-wire control system were test flown in daytime, good weather conditions. The YF-16 aircraft is able to withstand sustained high g-loads and maneuver in vertical climbs. The full maneuvering potential of the aircraft is still unknown as is the performance of the fly-by-wire flight control system in the presence of major electrical disturbances. T.S.

A75-10018 A response criterion for aircraft with fly-by-wire control systems. G. S. Campbell (Connecticut, University, Storrs, Conn.). *Simulation*, vol. 22, May 1974, p. 145-148. 6 refs.

In a fly-by-wire flight control system the pilot's commands are transmitted to the control surfaces only via electrical wires. The system makes use of feedback to control the vehicle motion. Special criteria have been developed to describe acceptable response characteristics. A two-parameter criterion that could have advantages over a criterion with three parameters is described. An area of satisfactory response characteristics for aircraft with a fly-by-wire control system is indicated on the basis of a computational investigation. G.R.

A75-10043 # Turbulent mean velocity measurements on a rotating cone. M. L. Koosinlin and F. C. Lockwood (Imperial College of Science and Technology, London, England). *ASME, Transactions, Series I - Journal of Fluids Engineering*, vol. 96, Sept. 1974, p. 303-305. 5 refs.

The effect of four different inlet profiles on separation in a two-dimensional channel with a right-angle bend was investigated. The first profile was parabolic, the second represented slug flow, the third represented a developing flow, and the fourth had a constant shear across the channel. A laminar, isothermal, incompressible Newtonian fluid was assumed. The governing Navier-Stokes equations were expressed in terms of a dimensionless stream function and vorticity function and were solved by computer using a finite difference form of the equations in a single-step iteration procedure. Inlet profile has little effect on extent of separation and velocity distribution downstream from the corner. P.T.H.

A75-10140 # Axial flow past a cylinder with suction. L. J. Crane (Trinity College, Dublin, Ireland). *Zeitschrift für angewandte Mathematik und Mechanik*, vol. 54, Sept. 1974, p. 567-570. 6 refs.

Consideration of the laminar boundary layer of an axial flow subject to uniform suction in its development from the front of a long thin cylinder, where it is assumed to be of negligible thickness, until it ultimately attains Wuest's (1955) profile. An obtained Pohlhausen solution is corrected by comparison with an exact series solution. M.V.E.

A75-10186 Drone/RPV systems. W. W. Hemenway (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *Aeronautical Journal*, vol. 78, Aug. 1974, p. 355-362.

Consideration of the Remotely Piloted Vehicle (RPV) as a low cost system with applications in diverse roles of aerospace tactics. Special attention is given to the application of the RPV to aerospace power and system elements, and to the research and development activity currently underway. The drone/RPV design is discussed from the point of view of a total weapon system, with the control guidance as an essential element reviewed in detail. Additional programs and applications are Weather/Atmospheric Sampling, the Low Altitude Multi-Purpose Drone (LAMP), the Mini-Drone, and Drone Control and Data Retrieval System (DCDRS). T.S.

A75-10187 Helicopter - People and places /14th Cierva Memorial Lecture/. I. C. Cheeseman (Southampton, University, Southampton, England). *Aeronautical Journal*, vol. 78, Aug. 1974, p. 363-374. 29 refs.

The advantages of using helicopters as transport vehicles as they are related to people and their needs in an advanced technological society. The future of the helicopter in providing security and safety systems for use in emergencies and as an instrument in developing an important civil transport mode is reviewed. The objectives under consideration include the methods of reducing vibrational transmission and noise levels, the cost of helicopter operations, and helicopter safety devices. The application of helicopters for police activities and National Defense, and their use in freight transportation is included. T.S.

A75-10189 A method of obtaining sub-critical compressible velocities for two-dimensional aerofoils from an exact inviscid incompressible solution. B. Probert (British Aircraft Corp., Ltd., London, England). *Aeronautical Journal*, vol. 78, Aug. 1974, p. 380-383. 8 refs.

A75-10203 Heat and mass transfer in engines of flight vehicles (Teplo- i massoobmen v dvigateliakh letatel'nykh apparatov). Edited by V. K. Shchukin. Kazan, Kazanskii Aviatсионnyi Institut (KAI, Trudy, Seriya Aviatсионnye Dvigateli, No. 154), 1973. 69 p. In Russian.

The papers deal with experimental and theoretical studies of phenomena associated with heat and mass transfer effects in aircraft and rocket engines. The topics studied include such problems as the influence of swirl on the heat transfer in nozzles, the influence of thermal decomposition of polyene hydrocarbons on the effectiveness of heat shields, the theoretical determination of the radiation intensity of combustion products, the Dirichlet problem for a hollow cone, the determination of the temperature field of spot welded plates, and the derivation of formulas for calculating the heat transfer associated with injection-type boundary layer control. V.P.

A75-10204 # Influence of swirling flow on heat transfer in nozzles (Vliianie zakrutki potoka na teploobmen v soplakakh). V. K. Shchukin, P. A. Polikarpov, V. A. Filin, and A. P. Iakshin. In: Heat and mass transfer in engines of flight vehicles. Kazan, Kazanskii Aviatсионnyi Institut, 1973, p. 3-9. In Russian.

The influence of local swirling generated by seven different swirl vanes on the heat transfer in nozzles is studied experimentally. The influence of the swirl law, the angle of twist, and the distance of the swirl vane from the nozzle inlet is determined. V.P.

A75-10256 # The development program for the F-15 inlet. W. F. Imfeld (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1061.* 10 p.

Description of the F-15 variable capture area inlet and the associated control system. In addition to its effects on inlet behavior, the variable capture area reduces cruise drag, favorably influences aircraft longitudinal stability at low speeds and reduces loads on the inlet backup structure at certain supersonic conditions. The boundary layer bleed system optimization demonstrated that a slot in the throat was the single most effective location for bleed removal. Curving the compression ramp just forward of this slot, which also removes bypassed flow, improved bypass system flow capacity. Comparative results are presented for the final configuration between model and full-scale wind tunnel testing, and subsequent flight testing. Results show that full scale instantaneous distortion is typically equal to or less than that measured on a one-sixth scale model. (Author)

A75-10257 # The application of boundary layer suction to suppress strong shock-induced separation in supersonic inlets. W. F. Wong (Northrop Corp., Hawthorne, Calif.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1063.* 12 p. 5 refs.

An experimental investigation into the suppression of strong shock-induced separation in supersonic inlets with boundary layer suction was conducted. The test article consisted of a 0.2 scale fixed-geometry external compression isolated inlet configuration tested at a free-stream Mach number of 2 and a maximum unit Reynolds number per foot of 17,000,000. Successful suppression of shock-induced separation, arising from the interaction of a turbulent boundary layer and terminal or normal shock strengths to $M = 1.9$, was achieved with a total bleed equal to 3% of the inlet capture flow. The control was accomplished by applying continuous bleed upstream and across the shock-boundary layer interaction region. (Author)

A75-10258 # Inlet development for the B-1 strategic bomber. W. R. Haagenson and L. M. Randall (Rockwell International Corp., Los Angeles, Calif.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1064.* 9 p.

The B-1 inlet was originally a mixed compression design, but later changed to an external compression inlet (ECI). All major problems encountered in adapting the ECI to the B-1 were solved during the first wind tunnel development test. Aerodynamic characteristics of the inlet and, particularly, the characteristics of certain inlet control parameters are associated with the underwing location of the nacelle. Inlet distortion and inlet/engine compatibility have been carefully audited throughout the B-1 program. A demonstration of inlet/engine compatibility before first flight was provided by wind tunnel tests of a full-scale inlet/engine model at Arnold Engineering Development Center. (Author)

A75-10259 # Powerplant energy management. N. Epstein (General Electric Co., Airline Programs Div., Cincinnati, Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1066.* 7 p.

Current methods and future developments are reviewed that are aimed at improving the pilot's ability to schedule and control engine thrust in accordance with aircraft power requirements during various flight regimes. These methods vary from normal manual control by the pilot's throttle to a fully automated push-button system implemented by a combination of electronic and hydromechanical devices. Estimates of potential savings in fuel to result from optimum thrust management are presented for modern wide-body transports. Also, modifications in current normal operational/airport practices are suggested, and their impact on fuel consumption is examined. (Author)

M.V.E.

A75-10260 # Aids - Expectations past, present and future. J. W. Allison and T. W. Dieckmann (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1067.* 14 p.

The components of airborne integrated data system hardware installed on wide-body commercial aircraft are listed for each of the major wide-body equipment operators, and the significant engine parameters monitored are pointed out. Currently used methods of engine analysis such as takeoff exhaust gas temperature/throttle position prognostics, and trending of start, takeoff, climb, and cruise are discussed, along with a relatively new method of analysis utilizing a diagnostic matrix. Also, a new concept referred to as Engine Module Performance Analysis is introduced. (Author)

M.V.E.

A75-10261 # The digital electronic propulsion control system - Problems and payoffs. J. F. Kuhlberg and D. M. Newirth (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1068.* 9 p.

Review of the technological advances that will make possible a digital electronic propulsion control system designed around a prime reliable electronic computer capable to meet the control requirements of the advanced turbine engines of the mid 1980s and do away with the need for hydromechanical control systems. The benefits to be derived from such a prime reliable electronic control system include reductions in control system costs, fuel consumption, and aircraft weight. (Author)

M.V.E.

A75-10275 # Two dimensional transonic two-phase flow in axisymmetric nozzles. L. J. Jacques and J. A. M. Seguin (Société Européenne de Propulsion, Blanquefort, Gironde, France). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1088.* 8 p. 8 refs.

A new two-dimensional technique for the computation of the transonic flowfield through axisymmetric nozzles has been developed to provide improved initial values to compute the downstream supersonic flow. The governing equations for the two-phase flowfield, being first-order quasi-linear partial differential equations, make it possible to define an iterative numerical technique, using initial data calculated by the equilibrium gas-particle mixture flow model. This technique uncouples at each iteration the calculation of gas-phase properties from that of the particle phase properties. The new feature of this technique is the compatibility condition that governs the sonic conditions and the limiting mass flow rate. A more rigorous description of the transonic flowfield is thus obtained, as well as an improved estimation for the mass flow rate. (Author)

A75-10278 * # Comparison of the acoustic characteristics of large-scale models of several propulsive-lift concepts. M. D. Falarski (U.S. Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif.), T. N. Aiken, K. Aoyagi, and D. G. Koenig (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1094*. 10 p. 10 refs. Research supported by the Department of National Defence and DeHavilland Aircraft of Canada, and NASA.

Wind-tunnel acoustic investigations were performed to determine the acoustic characteristics and the effect of forward speed on the over-the-wing externally blown jet flap (OTW), the under-the-wing externally blown jet flap (UTW), the internally blown jet flap (IBF), and the augmentor wing (AW). The data presented represent the basic noise generated by the powered-lift system without acoustic treatment, assuming all other noise sources, such as the turbofan compressor noise, have been suppressed. Under these conditions, when scaled to a 100,000-lb aircraft, the OTW concept exhibited the lowest perceived noise levels, because of dominant low-frequency noise and wing shielding of the high-frequency noise. The AW was the loudest configuration, because of dominant high-frequency noise created by the high jet velocities and small nozzle dimensions. All four configurations emitted noise 10 to 15 PNdB higher than the noise goal of 95 PNdB at 500 ft. (Author)

A75-10279 # Electromagnetic compatibility assurance tests for airborne systems controls in an RF-polluted environment. C. J. Hanover (General Motors Corp.; Detroit Diesel Allison Div., Indianapolis, Ind.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1096*. 8 p.

Bench tests and signal levels are described which have been successfully used to duplicate high level RF radiated conditions. Many test kit designers are not aware of the susceptibility problems of the system or of the RF levels in which the test kit will be used. Thus susceptibility problems are increased when test kit leads are attached for electronic systems checkout, since the test cables can act as antennas. The complete system, including the use of test kits, should be tested in RF environments of 100 V/m for the lower frequencies and 9 MW/sq cm (184.2 V/m) for the higher frequencies. A typical test program is described with some of the problems that can be encountered, circuit isolation techniques, and corrective action. (Author)

A75-10281 # Turbofan noise reduction using a near sonic inlet. R. L. Koch, T. M. Ciskowski, and J. R. Garzon (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1098*. 7 p.

A fixed geometry, near sonic inlet demonstrated a concept for reducing the forward radiated fan noise from a turbofan engine for an advanced transport aircraft. Performance tests were conducted on an 8 in. (203 mm) scale model fan to compare the near sonic inlet with a conventional inlet bell. A 15 dB sound level attenuation at blade-pass-frequency was demonstrated at an average throat Mach number of approximately 0.79. The design goal of efficient aerodynamic performance was achieved with pressure recoveries of at least 0.993 and no discernable effect on fan performance. (Author)

A75-10282 # F-14A installed nozzle performance. W. C. Schnell (Grumman Aerospace Corp., Bethpage, N.Y.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1099*. 19 p. 24 refs.

An overview of the Convergent-Divergent (C-D) Iris exhaust nozzle, as installed in the widely-spaced TF30 engine nacelles of the F-14A fighter, is presented along with nozzle/airframe model testing

and force accounting techniques. Nozzle selection, as influenced by total integration with the aircraft, is discussed not only in terms of high nozzle performance but also as a proper balance within the overall system. Backend improvements, developed in the wind tunnel and substantiated in flight, reduced aircraft minimum drag by 6.5%. Tunnel and flight data correlations are shown. Future full-scale instrumented C-D Iris testing - a Reynolds Number research tool - is outlined. (Author)

A75-10283 # F-15 nozzle/afterbody integration. R. E. Martens (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1100*. 9 p.

The performance of the F-15 represents a significant improvement over that of current operational fighter aircraft. A major contributor in attaining this improvement was the efficient integration of the engine and nozzle with the airframe. This integration was accomplished experimentally because the nozzle/afterbody flow field is too complex for theoretical evaluation. During the F-15 development program, both two-dimensional and axisymmetric nozzle installations were considered. The considerations leading to the selection and performance substantiation of the F-15 nozzle/afterbody configuration are reviewed in this paper. (Author)

A75-10292 # Expendable solid propellant boost motors for small target aircraft. A. L. Deans (Department of Defence, Australian Defence Scientific Service, Salisbury, Australia). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1125*. 10 p. 5 refs.

The Rodinga motor, designed and produced in Australia for the Turana Target Drone System, is described. The performance, including that of a simple pitch plane thrust vector control, is given. Reference is made to acceptance trials, associated equipments and aspects of performance measurements. The importance of motor manufacturing costs on the operating system costs is shown and the philosophy applied to an R&D study on a motor (Carina) which would cost considerably less than the Rodinga motor is included in a description of development to June, 1974. The course of further development is indicated including possibilities for further cost reduction. (Author)

A75-10306 # A test technique for inlet/aircraft drag evaluation. J. V. Rejeske (McDonnell Aircraft Co., St. Louis, Mo.) and D. Stava (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1145*. 7 p.

A new technique for evaluating inlet and inlet/airframe interaction forces is discussed. This technique features a two-balance system with thermal control and long hollow sting supports that enter the model through the exit nozzles. The two balances permit simultaneous measurement of inlet forces and moments, and aircraft forces and moments. The hollow sting tubes, in addition to supporting the model, serve as mass flow tubes, thereby providing a minimum interference support system, eliminating the effects of a flowing exhaust, and permitting remote control of inlet airflow. Results of an evaluation test at subsonic conditions, utilizing a high speed fighter aircraft configuration, are presented. (Author)

A75-10317 # Flow immediately behind a step in a supersonic combustor. R. C. Orth and J. M. Cameron (Johns Hopkins University, Silver Spring, Md.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1161*. 8 p. 8 refs. Contract No. N00017-72-C-4401.

Results are presented from a series of nonburning flow tests in which extensive instream and wall pressure and fluid sample measurements were made to characterize the flow immediately

behind a rearward facing step in a supersonic combustor. Pitot pressure data were used to determine simplified flowfield models for the cases of flow both with and without a simulated pre-combustion shock and simulated fuel injection. The effects of the shock on the flowfield and fuel-air distribution in the main stream and recirculation zone behind the step, as well as the implications for the placement of ignition devices and piloting, are discussed. (Author)

A75-10318 # Prediction of ground effects for VTOL aircraft with twin lifting jets. J. Louisse and F. L. Marshall (Boeing Aerospace Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1167.* 7 p. 13 refs.

An empirical method has been developed for predicting ground-effect thrust losses, often called 'suckdown' losses, for side-by-side rectangular-jet configurations. The method combines available flat-plate single-jet suckdown correlations (adapted to high- and low-wing airplane configurations) with a new correlation for the fountain effect associated with twin jets. The fountain correlation is based on a new experimental investigation in which nozzle variables were parametrically varied. Properly configured rectangular nozzles were found to produce a favorable fountain effect which largely cancels the suckdown losses. Considerably weaker fountains were observed for twin round nozzle configurations. (Author)

A75-10319 # V/STOL deflector concepts. T. A. Wynosky, R. A. Streib, and W. J. Usab (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1168.* 11 p.

A conceptual design study was conducted to formulate new and unique deflector concepts. The study concentrated on ventral deflector arrangements and their influence on engine performance and stability. The uniqueness of these ventral schemes is attributed to the configuration which allows the vertical thrust vector to be positioned at any station from immediately behind the fan (of a turbofan engine) and aft. The various relatively light weight mechanical schemes that were postulated are presented. Several nozzle blocker schemes, devised for use in conjunction with the deflectors, are also presented. One of the more attractive nozzle blocker configurations also has the capability of moderate angle thrust vectoring so that, if installed properly, it can induce supercirculation around the wing. (Author)

A75-10320 # Exhaust nozzle deflector systems for V/STOL fighter aircraft. J. A. Lander (General Electric Co., Cincinnati, Ohio) and J. L. Palcza (U.S. Naval Air Propulsion Test Center, Trenton, N.J.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1169.* 10 p.

Advanced multi-mission V/STOL fighters require high specific thrust (afterburning) engines. Combat and Ps mission points usually size the propulsion system such that the required lift is potentially available from the cruise engines. From an overall system weight standpoint, it is desirable that the maximum amount of onboard cruise engine thrust be utilized in vertical operation. This paper presents the results of analytical and experimental studies which evaluate several exhaust nozzle/deflector systems capable of operation at dry and afterburning power settings. (Author)

A75-10321 # Test and evaluation of a fighter aircraft in-flight thrust reverser. D. L. Linderman (Rohr Industries, Inc., Chula Vista, Calif.), C. A. Hoelzer (Grumman Aerospace Corp., Bethpage, N.Y.), and P. W. Howard (U.S. Navy, Naval Air Systems Command,

Washington, D.C.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1170.* 14 p. 15 refs. Navy-sponsored research.

The design, test and evaluation of a prototype in-flight thrust reverser installed on a Grumman F-11A fighter aircraft is described. Objectives of the Navy sponsored program are discussed. The design evolution and a description of the thrust reverser hardware and control system are presented. The demonstration flight test program conducted at Grumman's Calverton Flight Test Facility is reviewed. A description of the Navy tactical flight evaluation program currently being conducted at Patuxent River Naval Air Test Center is

presented. Flight test performance, stability and control data are presented and correlated with wind tunnel model test data. (Author)

A75-10322 * # Variable geometry for supersonic mixed-compression inlets. N. E. Sorensen, E. A. Latham, and D. B. Smeltzer (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1172.* 5 p. 8 refs.

Study of two-dimensional and axisymmetric supersonic mixed-compression inlet systems has shown that the geometry of both systems can be varied to provide adequate transonic airflow to satisfy the airflow demand of most jet engines. Collapsing geometry systems for both types of inlet systems provide a generous amount of transonic airflow for any design Mach number inlet system. However, the mechanical practicality of collapsing centerbodies for axisymmetric inlet systems is doubtful. Therefore, translating centerbody axisymmetric inlets with auxiliary airflow systems to augment the transonic airflow capability are an attractive alternative. Estimates show that the capture mass-flow ratio at Mach number 1.0 can be increased approximately 0.20 for a very short axisymmetric inlet system designed for Mach number 2.37. With this increase in mass-flow ratio, even variable-cycle engine transonic airflow demand can be matched without oversizing the inlet at the design Mach number. (Author)

A75-10323 # An analytical procedure for the calculation of attached and separated subsonic diffuser flows. W. W. Bower (McDonnell Aircraft Co., St. Louis, Mo.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1173.* 13 p. 15 refs.

An analytical procedure for computing the static and total pressure distributions in subsonic diffusers with axisymmetric or two-dimensional cross sections is described. It includes velocity profile and shear stress parameters which apply to attached and separated flows and allows for a strong interaction between the inviscid and viscous portions of the duct flow. With this approach, solutions can be obtained for separated regions where conventional boundary layer methods fail. Analytical and experimental static and total pressure distributions are compared for plane-wall and conical diffusers. An approximate technique is used to apply the analysis to actual aircraft diffusers. (Author)

A75-10324 # Rapid calculation of propulsion system installation corrections. W. H. Ball (Boeing Aerospace Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1174.* 10 p. 7 refs. Contract No. F33615-72-C-1580.

A calculation procedure has been developed to help evaluate installed propulsion system performance during preliminary studies of advanced military aircraft. The method is based on experimental and theoretical data relating geometric and aerodynamic variables to spillage drag, pressure recovery boundary layer bleed drag, boattail drag, and nozzle interference effects. The procedure accounts for

throttle-dependent effects on total pressure recovery and drag. Maps of standardized format, consistent with an acceptable force accounting system, are used to provide recovery and drag as a function of engine corrected airflow. A description is presented of the computer program that uses the calculation procedure to correct uninstalled engine data for installation effects. Results are presented to show the agreement obtained between calculated and measured installation corrections. (Author)

A75-10325 # A flow field model for, and some studies on the drag of, an engine exhaust system at transonic flight speeds. T. H. Moulden, J. M. Wu (Tennessee, University, Tullahoma, Tenn.), and D. J. Spring (U.S. Army, Missile Command, Redstone Arsenal, Ala.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1175*. 10 p. 12 refs. Grant No. DAAH01-74-C-0183.

The paper is in two parts. The first part discusses the physical nature of a transonic strong interaction such as is found when an exhaust jet issues from a nozzle exit plane into a near sonic free-stream. The second part presents some results from a calculation technique. These results discuss the influence of Reynolds number on such interacting flows. (Author)

A75-10333 # Small turbine engine technology. W. J. McAnally, III (United Aircraft Corp., Pratt and Whitney Aircraft Div., West Palm Beach, Fla.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1184*. 6 p. Research supported by the United Aircraft Corp. and U.S. Army.

Future small turbine engines can offer a 10 to 20% reduction in specific fuel consumption relative to current engines by operating at increased turbine inlet temperatures and higher cycle pressure ratios. Pratt and Whitney Aircraft's small turbomachinery component development has been concentrated on single-stage, centrifugal compressors and single-stage, cooled axial turbines. Development of a 10:1 pressure ratio centrifugal compressor shows that good efficiency can be obtained over a wide operating range using variable-inlet guide vanes, a remote transonic inducer, and a conical pipe diffuser. Evaluation of a small, high-work, transonic axial turbine with relatively thick low-aspect-ratio airfoils, typical of cooled designs, indicates that high efficiencies can be obtained with minimum cooling air penalties. This technology has been used for the design of a single-stage centrifugal and single-stage axial turbine rotor assembly for an engine gas generator. (Author)

A75-10334 # Small flying engines are different. E. H. Benstein (Teledyne CAE, Toledo, Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1185*. 22 p. 71 refs.

Questions regarding the definition of small and large gas turbines are considered, giving attention to aspects of configurations, performance, and design. Operational capabilities of small flying turbines are examined, taking into account the current operational regime and capabilities which will presumably be attained within the next five years. Application areas of small engines include helicopters, business aircraft, RPV, and missiles. Differences between large and small engines are related to compressor configuration, the transition duct, combustor configuration, and casing diameter. It is pointed out that small flying engines are almost a full development generation behind their large counterparts. G.R.

A75-10335 # The Detroit Diesel Allison Model 250-C28 turboshaft engine. E. P. Neate (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind.). *American Institute of Aeronautics*

and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1186. 9 p.

The Model 250-C28 engine is being developed to accommodate the light turbine helicopters which continue to increase in gross weight. This is an evolutionary engine exploiting all good features of its predecessors and the results are a blend of field-proved state-of-the-art concepts. During the design phase special attention was given to the environmental impact of the new model, and each component was designed for minimum noise, smoke, and exhaust emissions. Incorporation of a new combustion chamber design to reduce exhaust pollutants also greatly increased water slug ingestion capability, making this an excellent helicopter engine. (Author)

A75-10336 * # Sealing technology for aircraft gas turbine engines. L. P. Ludwig and R. L. Johnson (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1188*. 12 p. 23 refs.

Experimental evaluation under simulated engine conditions revealed that conventional mainshaft seals have disadvantages of high gas leakage rates and wear. An advanced seal concept, the self-acting face seal, has a much lower gas leakage rate and greater pressure and speed capability. In endurance tests (150 hr) to 43,200 rpm the self-acting seal wear was not measurable, indicating that noncontact sealing operation was maintained even at this high rotative speed. A review of published data revealed that the leakage through gas path seals has a significant effect on thrust specific fuel consumption, stall margin, and engine maintenance. Reducing leakages by reducing seal clearances results in rubbing contact, and then the seal thermal response and wear determines the final seal clearances. (Author)

A75-10337 # Oscillating jet nozzles for V/STOL application. H. Viets (USAF, Aerospace Research Laboratories, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1189*. 11 p. 18 refs.

A nozzle development program was undertaken to produce a time dependent flow at the nozzle exit. The oscillatory character of the flow was achieved without the use of moving parts by incorporating a fluidic feedback loop into the nozzle design. The nozzle thrust efficiencies approached 90 percent and the half width spreading rates attained exceeded that of the slot nozzle by a factor of more than three. (Author)

A75-10338 # An analytic description of hypermixing and test of an improved nozzle. P. M. Bevilacqua (USAF, Aerospace Research Laboratories, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1190*. 9 p. 7 refs.

A novel method for increasing the rate of jet mixing by the production of streamwise vortices has been developed. An analytic description of this hypermixing effect is obtained with an eddy viscosity whose length and velocity scales are proportional to the vortex size and rotational speed. The prediction of this analysis are compared with experimental results for the growth of hypermixing jets, and the generalization to other shear flows is discussed. Tests of an improved hypermixing nozzle show that the length of the thrust augmenting ejector developed at ARL can be almost halved with no loss in augmentation. (Author)

A75-10339 # A computer program for aircraft thrust ejector analyses. G. R. Salter (Bell Aerospace Co., Buffalo, N.Y.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1191*. 11 p. 12 refs.

A digital computer program is described for aircraft ejector performance analyses. The effects on performances of temperature ratios, pressure ratios, specific-heat ratios, pressure losses, and aircraft forward speed are included. Momentum correction factors are computed within the program, and the method by which these are determined for rectangular ejectors with multiple nozzles is described. A similar approach applied to cylindrical ejectors is shown to give close agreement with test data. Theoretical and experimental results are compared for rectangular ejectors employing hypermixing nozzles and microjet nozzles, and it is demonstrated that the predictions of thrust augmentation ratio are to within 3% of the test data. The effects on performance of pressure ratio, temperature ratio, nozzle spacing, mixing section-length, inlet and diffuser performances, and the degree of mixing achieved are presented.

(Author)

A75-10340 # Ejector thrust augmentation for STOL aircraft applications. H. G. Streiff and C. Henderson (Bell Aerospace Co., Buffalo, N.Y.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1192.* 9 p. 5 refs.

Wind tunnel test results and correlations with developed analytical prediction techniques are presented for a large scale two-dimensional model of a Bell Aerospace Company ejector thrust augmentation wing system applicable to STOL aircraft. Tests were conducted in the Lockheed-Georgia Co. V/STOL wind tunnel over a range of geometric and flow conditions representative of STOL operations. Thrust augmentation ratios (referenced to isentropic primary) in excess of 1.7 were obtained statically and increased with increasing airspeed. Slot nozzles for boundary layer control had a major beneficial effect on ejector and aerodynamic performance. Superposition of the ejector sink effect with jet flap theory gave good correlations with aerodynamic results.

(Author)

A75-10341 # Engine flow diverter system for the XFV-12A prototype aircraft. C. E. Swavely (United Aircraft Corp., Pratt and Whitney Aircraft Div., West Palm Beach, Fla.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1194.* 10 p. Research supported by the Rockwell International Corp. and U.S. Navy.

A translating plug nozzle shroud and diverter door system has been developed to provide F401 engine exhaust gas flow for the XFV-12A thrust augmented wing nonafterburning prototype V/STOL aircraft. Hot-gas-flow scale model tests were conducted to verify parametric design studies and to provide early diverter design information. Engine and diverter ground tests verified that engine gas flow could be alternately diverted from axial discharge to radial discharge (vertical mode) without adversely affecting engine operation. The F401 engine vertical-mode operating conditions matched conventional engine operation with a reference convergent nozzle, demonstrating that normal engine conditions could be maintained during diverted operation. Diverter pressure losses were within predicted values, indicating that turning losses could be minimized by proper design.

(Author)

A75-10342 # Statistical averages of subsonic inlet distortion. L. T. Clark (Boeing Commercial Airplane Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1197.* 9 p. 11 refs. Research supported by the Boeing Commercial Airplane Co.

Results of an experimental investigation of dynamic distortion in a typical subsonic aircraft inlets are discussed. The purpose of the investigation was to study the possibilities for representing the dynamic distortion in terms of statistical averages. Results suggest that a sufficient measure of the distortion can be obtained using cross correlation of the signals from transducers placed only in the regions of significant dynamic activity. The method would be

practical for subsonic inlets where the distortion is localized in predictable places in the inlet. A very good agreement was found between the gradient of mean total pressure and unsteady activity. Contour maps of the mean total pressure gradient can be used to accurately locate unsteady regions. Cross correlations between pressure signals within the turbulent region were used to provide the necessary measure of the size of the turbulence.

(Author)

A75-10344 # Development and experimental verification of a technique to test full-scale inlet/engine systems at maneuvering conditions. R. L. Palko (ARO, Inc., Propulsion Wind Tunnel Facility, Arnold Air Force Station, Tenn.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1199.* 9 p.

A75-10349 # A test cell engine diagnostic system - From research to reality. P. F. Piscopo and R. T. Lazarick (U.S. Naval Air Propulsion Test Center, Trenton, N.J.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1207.* 9 p.

The Naval Air Propulsion Test Center commenced a research program in FY72 to develop and evaluate diagnostic logic techniques and advanced engine sensors. This has resulted in the development of sensors and software capable of diagnosing 90 problems in the categories of vibration, oil, hot section, and aerothermodynamic performance analysis. The results of this 3-year effort are currently being incorporated into a portable diagnostic system for test cell use which gathers, analyzes, and displays information to the test engineer in real time.

(Author)

A75-10414 The development of an accurate aerodynamic simulation model for the SAM-D missile with a relatively small computer storage requirement. E. J. McLaughlin (Martin Marietta Aerospace, Orlando, Fla.). In: *Summer Computer Simulation Conference, Houston, Tex., July 9-11, 1974, Proceedings. Volume 1.* Montvale, N.J., AFIPS Press, 1974, p. 398-410.

A75-10426 High-performance hydraulic system powers aircraft simulator. B. Bell, Jr. *Hydraulics and Pneumatics*, vol. 27, Oct. 1974, p. 184-187.

Details regarding the system power supply are examined. Each main variable-displacement, axial piston pump is driven by a 250-horsepower electric motor. The pumping system is in a covered, underground pit to minimize noise. Aspects concerning the hydraulic circuits are discussed along with details regarding the safety system design, the design of the hydraulic package, questions of servovalve design, transmission lines, and snubbing requirements.

G.R.

A75-10518 A wind energy conversion system based on the tracked-vehicle airfoil concept. R. E. Powe, H. W. Townes, E. H. Bishop, and D. O. Blacketter (Montana State University, Bozeman, Mont.). In: *Intersociety Energy Conversion Engineering Conference, 9th, San Francisco, Calif., August 26-30, 1974, Proceedings.* New York, American Society of Mechanical Engineers, 1974, p. 288-297. 20 refs. NSF Grant No. GI-39415.

A unique momentum interchange device for extraction of energy from the wind is described. It is shown that the maximum possible energy extraction with this tracked-vehicle airfoil device is greater than that for a conventional windmill. A comprehensive mathematical model is developed for the device, and this model is programmed for solution on a digital computer. This program is written so that wind spectrum data for any geographic location can be used to determine the monthly energy output for that location.

Results from this program indicate that this device could make significant contributions to electrical power requirements. For example, a system 8 km long and consisting of airfoils 12 meters in length with a 3-meter chord could supply the electrical energy needs of about 15,000 people. These results are presented in a form which indicates the effect of changing various design parameters. (Author)

A75-10542 The use of hydrogen in commercial aircraft - An assessment. E. M. Dickson, T. J. Logothetti, J. W. Ryan, and L. W. Weisbecker (Stanford Research Institute, Menlo Park, Calif.). In: Intersociety Energy Conversion Engineering Conference, 9th, San Francisco, Calif., August 26-30, 1974, Proceedings. New York, American Society of Mechanical Engineers, 1974, p. 468-478. 30 refs. NSF-sponsored research.

A review of the main technical and economic considerations pertinent to the use of hydrogen in commercial aircraft indicates that a hydrogen-fueled aviation system makes a great deal of sense, though many technical, institutional, social, environmental, and economic issues need to be understood more clearly before private or public decisions to support a hydrogen-based commercial aviation industry would be justified. The prospects of switching aviation to hydrogen seem much better than those for switching automobiles.

M.V.E.

A75-10621 The stability of a trailing line vortex. II - Viscous theory. M. Lessen and F. Paillet (Rochester, University, Rochester, N.Y.). *Journal of Fluid Mechanics*, vol. 65, Oct. 2, 1974, p. 769-779. 13 refs.

In the analysis, both timewise and spacewise growth rates are calculated for the lowest three negative nonaxisymmetric modes ($n = -1, -2$, and -3). Vortex intensity is characterized by a swirl parameter q proportional to the ratio of the maximum swirling velocity to the maximum axial velocity defect. The large wavenumbers associated with the disturbances at large n/q allow the $n = -1$ mode to have the minimum critical Reynolds number of 16 (q about equal to 0.40). The other two modes investigated have minimum Reynolds numbers on the neutral curve of 31 ($n = -2, q = 0.60$), and 57 ($n = -3, q = 0.80$). For each mode, the neutral-stability curve is shown to shift rapidly toward infinite Reynolds numbers once the swirl becomes sufficiently large.

F.R.L.

A75-10623 Mini-RPV's for cheap and no risk air power. R. T. Davis. *MicroWaves*, vol. 13, Oct. 1974, p. 40-42, 44, 46-48. 5 refs.

Evaluated is low-cost technology to be used in mini-RPV aircraft with special attention given to reconnaissance and surveillance missions. Different video-compression techniques are described from the standpoint of frame-rate reduction, resolution reduction, and image transformation. The Advanced Research Projects Agency (ARPA) is evaluating three spread-spectrum techniques including direct sequence pseudo-noise, frequency hop, and chirp radar communications. A table summarizes the anti-jam margins that are possible by each spread-spectrum method. The building of a mini-RPV with C-band command and data links, called the Mark II and intended for army battle field support, is discussed. Present program efforts aim to develop propulsion units that will meet with military standards, secure up/down links, and a multiple RPV control system.

T.S.

A75-10625 Doppler radar boast design innovations. V. M. Andreone and C. N. Bates (Teledyne Ryan Aeronautical Co., San Diego, Calif.). *MicroWaves*, vol. 13, Oct. 1974, p. 72, 75-80, 82.

A design review is presented of the key microwave components of the AN/APN-200 Doppler velocity sensor used to measure aircraft ground speed and drift angle, and specifically developed for Lockheed's S-3A carrier-based ASW aircraft and for the E-3A Airborne Warning and Command System aircraft. Improvements in equipment reliability and maintainability and in life-cycle costs of

the avionics are discussed along with specific examples of improved microwave technology in the AN/APN-200 design. The latter include a high efficiency planar array fixed antenna, a K-band Impatt diode transmitter, and stripline circuits to replace waveguide components. The principal types of radar modulation techniques developed for airborne Doppler velocity sensors are described.

T.S.

A75-10638 # Development of an armored T-28 aircraft for probing hailstorms. W. R. Sand and R. A. Schleusener (South Dakota School of Mines and Technology, Rapid City, S. Dak.). *American Meteorological Society, Bulletin*, vol. 55, Sept. 1974, p. 1115-1122. 15 refs. NSF Grant No. C-460.

The development of the T-28 aircraft for the penetration of hailstorms. The vehicle structure was strengthened, a larger engine provided, and all leading edges were armor plated. To record the interior structure of hailstorms, meteorological data were combined with the pilot's visual observations. The T-28 is equipped with alcohol de-icing for the propeller and carburetor, and it is directed to dilemma - how to measure the flow at the rotor disk without interfering with it and without concern for the physical impact of the blades when passing the measurement point. It has been demonstrated in recent experimental work that the dilemma may be solved by use of laser Doppler velocimeter (LDV) equipment. In September 1973, LDV techniques were applied to a model rotor in a wind tunnel, and velocities were measured at several radial and vertical positions in the close proximity to a passing blade. This is believed to be the first successful application of an LDV system to measure rotor downwash velocities in a wind tunnel.

(Author)

A75-10675 FAA Advisory Circular 00-41 Quality System Certification Program. D. E. Linden (FAA, Industrial Div., Washington, D.C.). *Journal of Quality Technology*, vol. 6, Oct. 1974, p. 202-206.

A new addition to the family of quality system specifications shows its precocity by being more advanced than its predecessors. The certification program spreads the role of quality control from the design conception through the final product perhaps more thoroughly than in any previous system specification. It also incorporates the quality control system plan as part of the FAA contract award, a step not taken under MIL-Q-9858A where only that specification is referenced in the contract. The new Advisory Circular extends the system found successful in achieving flight safety to air traffic control, navigational aids, and ground-support equipment and systems.

(Author)

A75-10721 Loadings and flight limitations of the sailplane having the speed flap. I. W. Stafiej and B. Biala. *Aero-Revue*, Oct. 1974, p. 610, 611.

A75-10799 Emission of smoke and fumes at temperatures up to 500 C. A. J. Christopher, E. J. P. Fear, and T. R. F. W. Fennell (Royal Aircraft Establishment, Farnborough, Hants., England). *Journal of Fire and Flammability, Combustion Toxicology Supplement*, vol. 1, Aug. 1974, p. 177-186.

For use in aircraft and other enclosed environments, a technique is described that estimates the temperature at which stages in pyrolytic decomposition of materials takes place. Smoke patterns using various materials such as polyamides, heat-resistant fabrics, fluorinated polymers, and various forms of cellulose are evaluated. Some subjective tests relating the steps on fume traces to the sense of smell are summarized.

T.S.

A75-10837 An extension of the 'parabolic method' to the calculation of transonic flows (Eine Erweiterung der 'Parabolischen Methode' zur Berechnung schallnaher Strömungen). K. H. Oehmen and I. Teipel (Hannover, Technische Universität, Hannover, West Germany). *Zeitschrift für Flugwissenschaften*, vol. 22, Sept. 1974, p. 307-313. 10 refs. In German. Research supported by the Deutsche Forschungsgemeinschaft.

Although the 'parabolic method' or its specialization, the 'local linearization method', in many cases give good results in comparison with experiments, there is no rigorous analysis when developing the different steps. An attempt is made to improve the original procedure by solving an inhomogeneous parabolic differential equation. For this equation an iteration procedure is introduced. The results for different profiles show good agreement with experiments, even in cases where the maximum thickness has been displaced to the front part of the profile. (Author)

A75-10839 Measurement of model helicopter rotor flow velocities with a laser Doppler velocimeter. A. J. Landgrebe and B. V. Johnson (United Aircraft Research Laboratories, East Hartford, Conn.). *American Helicopter Society, Journal*, vol. 19, July 1974, p. 39-43. 6 refs.

The velocity data of primary interest to the rotor aerodynamicist are the instantaneous local velocities at the blades and in the plane of the rotor disk. The accurate measurement of these velocities has always presented the rotor experimentalist with a dilemma - how to measure the flow at the rotor disk without interfering with it and without concern for the physical impact of the blades when passing the measurement point. It has been demonstrated in recent experimental work that the dilemma may be solved by use of laser Doppler velocimeter (LDV) equipment. In September 1973, LDV techniques were applied to a model rotor in a wind tunnel, and velocities were measured at several radial and vertical positions in the close proximity to a passing blade. This is believed to be the first successful application of an LDV system to measure rotor downwash velocities in a wind tunnel. (Author)

A75-10840 # Gas turbine engines - A state-of-the-art review. *Aircraft Engineering*, vol. 46, Sept. 1974, p. 6-11, 13-15.

Developments in each of the three Rolls Royce aircraft engine divisions is described. The Rolls Royce Derby Engine Division, by improving the airflow over the rear of the engine and between the pylon-mounted engine and the Tri-Star's wing, has designed a new afterbody with a 15 degree half-cone angle, that will provide a further 1.5 to 3% reduction in fuel consumption over that of the 11 degree afterbody. The RB 199 three-shaft reheated turbofan, developed by the Rolls Royce Bristol Engine Division gives a high thrust with reheat for compact maneuver and supersonic acceleration while having low fuel consumption. The Small Engine Division of Rolls Royce is working jointly with two other European companies to develop a small gas turbine engine, the EPM/ESM 600, for light fixed-winged aircraft and small helicopters. The engine will be in the 600hp range. It will have a minimum of parts, a specific fuel consumption, and a maximum interchangeability of parts between turboprop and turboshaft. T.S.

A75-10851 State of radome technology - 1974; Proceedings of the Twelfth Symposium on Electromagnetic Windows, Georgia Institute of Technology, Atlanta, Ga., June 12-14, 1974. Symposium sponsored by the Georgia Institute of Technology. Edited by J. N. Harris (Georgia Institute of Technology, Atlanta, Ga.). Atlanta, Georgia Institute of Technology, 1974. 173 p. \$6.00.

Computer analysis of radome influence on antenna radiation patterns by surface integration technique, an improved radome analysis technique for large aperture radar antenna systems, and lightning protection for advanced aircraft radomes based on the segmented lightning diverter strip are among the topics covered in

papers concerned with recent research and advances in radome technology. Other topics covered include high temperature radome effects on antenna radiation patterns, mechanical design and testing of a 1200 F glass-reinforced aluminum phosphate radome, and radome boresight error from wavefront measurements.

M.V.E.

A75-10857 # EM window thermal barriers. D. Purinton (Texas Instruments, Inc., Dallas, Tex.). In: State of radome technology - 1974; Proceedings of the Twelfth Symposium on Electromagnetic Windows, Atlanta, Ga., June 12-14, 1974.

Atlanta, Georgia Institute of Technology, 1974, p. 28-32. USAF-supported research.

Review of the mechanical, electrical, and thermal considerations involved in the design of a thermal barrier between a radome-sheltered phased array antenna system and the heat-producing boundary layers on high-supersonic aircraft. Special attention is given to the selection of the barrier location and materials. M.V.E.

A75-10858 # Radomes for high gain arrays. J. F. Konieczny (Rockwell International Corp., Anaheim, Calif.). In: State of radome technology - 1974; Proceedings of the Twelfth Symposium on Electromagnetic Windows, Atlanta, Ga., June 12-14, 1974.

Atlanta, Georgia Institute of Technology, 1974, p. 33-38. USAF-sponsored research.

Review of the results of an investigation of radome effects on a conventional gimbaled antenna and an electronically scanned array, and study of radome-caused monopulse parameter perturbations. The effects of high and moderate aspect ratio radomes on low and moderate sidelobe level high gain arrays are also discussed. M.V.E.

A75-10859 # Anisotropic dielectric panel analysis. D. G. Bodnar and H. L. Bassett (Georgia Institute of Technology, Atlanta, Ga.). In: State of radome technology - 1974; Proceedings of the Twelfth Symposium on Electromagnetic Windows, Atlanta, Ga., June 12-14, 1974.

Atlanta, Georgia Institute of Technology, 1974, p. 41-46. 8 refs. Contract No. F33615-71-C-1694.

A grooved-dielectric radome panel is analyzed in terms of an arbitrary direction of incidence on N planar slabs each of which is dielectrically anisotropic, homogeneous and lossless. Using this model for the grooved panel, transmission coefficients of 90 percent or greater over a 10:1 frequency band and over 0 to 60 deg incidence angle are predicted and demonstrated experimentally. Measurements are presented on two panels from 3 to 35 GHz. (Author)

A75-10866 # B-1 forward radome. R. C. Sparling and N. LoBue (Rockwell International Corp., Los Angeles, Calif.). In: State of radome technology - 1974; Proceedings of the Twelfth Symposium on Electromagnetic Windows, Atlanta, Ga., June 12-14, 1974.

Atlanta, Georgia Institute of Technology, 1974, p. 82-87.

Description of some of the procedures and results of the tests and analyses performed in connection with the design of the B-1 forward radome. The results of this work indicate that the B-1 forward polyimide/quartz type radome design yields transmission efficiencies from 82 to 95 percent for the terrain following/terrain avoidance radar antenna beam operating through the radome. M.V.E.

A75-10870 # Development of Slip Cast Fused Silica radomes. J. Y. Simon (Direction des Constructions et Armes Navales, Toulon, France). In: State of radome technology - 1974; Proceedings of the Twelfth Symposium on Electromagnetic Windows, Atlanta, Ga., June 12-14, 1974.

Atlanta, Georgia Institute of Technology, 1974, p. 103-107. Research supported by the Ministère de la Défense Nationale.

The application of Slip Cast Fused Silica (SCFS) radomes to air

missiles was investigated. Mechanical and rain erosion tests were conducted. Results showed that SCFS was not technically advantageous for low speeds up to Mach 4. In this range of speeds, the physical deficiencies and the mechanical weakness of the system outweighed the economical gain obtained by precision casting. To obtain good thermal and electrical behavior water tests were conducted. Solutions of aluminum oxychloride and ethylic silicate were used. After immersion in water for 16 hours the samples showed water absorption near 2.3 per cent for those sealed with silica and about 4 per cent for those sealed with alumina with the total open porosity remaining at a high level. A coating made of chromium oxide improved the performance. To qualify SCFS radomes for flights beyond Mach 4.5 preliminary tests were conducted where the thermal behavior of the radomes was examined in the S 4 Onera wind tunnel. T.S.

A75-10872 # Polyimide materials development for high temperature, broadband radome applications. A. J. Thompson and P. W. Harruff (Brunswick Corp., Marion, Va.). In: State of radome technology - 1974; Proceedings of the Twelfth Symposium on Electromagnetic Windows, Atlanta, Ga., June 12-14, 1974.

Atlanta, Georgia Institute of Technology, 1974, p. 112-116. Research supported by the Brunswick Corp.

The usability of polyimide-based materials in the fabrication of high-quality, broadband radome constructions is shown to have been demonstrated through design, fabrication, and tests in two distinct application areas: aircraft ECM radomes and missile radomes. Key items in the studies reported include the minimization of interface adhesives, the use of asymmetric sandwich configurations, and reduction in the syntactic foam dielectric as well as weight and cost. M.V.E.

A75-10875 # A rain erosion evaluation of three-dimensional woven silica and reaction sintered silicon nitride as state-of-the-art radome materials. J. S. Waugh and S. D. Goldstein. In: State of radome technology - 1974; Proceedings of the Twelfth Symposium on Electromagnetic Windows, Atlanta, Ga., June 12-14, 1974. Atlanta, Georgia Institute of Technology, 1974, p. 128-132.

A75-10876 # Radio frequency heating of radomes in an aerodynamic environment. K. D. Hill and J. D. Kelly (Boeing Aerospace Co., Seattle, Wash.). In: State of radome technology - 1974; Proceedings of the Twelfth Symposium on Electromagnetic Windows, Atlanta, Ga., June 12-14, 1974.

Atlanta, Georgia Institute of Technology, 1974, p. 133-137.

Study of the temperature distribution within three radome wall (i.e., solid, A-sandwich, and C-sandwich) design varieties, subjected to flight velocities ranging from 250 to 2000 ft/sec at altitudes from 5,000 to 75,000 ft and RF power densities from 0 to 30 W/sq in. The results include the findings that: (1) at high RF power densities, higher temperatures are encountered in thicker radome wall designs; (2) multiple sandwich designs, such as the C-sandwich, are likely to present more difficulties than A-sandwich or solid wall design because of the presence of an internal lossy layer; (3) for a given velocity, the maximum radome temperature decreases with increasing altitude up to 50,000 ft; and (4) at altitudes above 50,000 ft, the maximum radome temperature shows increases which are due to the atmospheric temperature anomaly at the altitude of 54,000 ft. M.V.E.

A75-10877 # Lightning protection for advanced aircraft radomes based on the segmented lightning diverter strip. L. C. Hoots, S. A. Moorefield (Brunswick Corp., Marion, Va.), J. R. Stahmann (Lightning and Transients Research Institute, Minneapolis, Minn.), and M. P. Amason (Douglas Aircraft Co., Long Beach, Calif.). In: State of radome technology - 1974; Proceedings of the Twelfth

Symposium on Electromagnetic Windows, Atlanta, Ga., June 12-14, 1974. Atlanta, Georgia Institute of Technology, 1974, p. 138-143. Contract No. F33615-71-C-1380.

A75-10880 # Thermal plastic radomes. K. W. Foulke (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: State of radome technology - 1974; Proceedings of the Twelfth Symposium on Electromagnetic Windows, Atlanta, Ga., June 12-14, 1974. Atlanta, Georgia Institute of Technology, 1974, p. 151-155.

Thermal plastics used for small radomes on several Navy aircraft are shown to have performed so well as to warrant their inclusion in the currently proposed revision of the general specification for radomes. The use of thermal plastics for inexpensive small radomes is believed to provide a very practical solution to many present radome problems. M.V.E.

A75-10881 # B-1 forward radome fabrication. J. B. Styron and S. A. Moorefield (Brunswick Corp., Marion, Va.). In: State of radome technology - 1974; Proceedings of the Twelfth Symposium on Electromagnetic Windows, Atlanta, Ga., June 12-14, 1974. Atlanta, Georgia Institute of Technology, 1974, p. 156-160. Contract No. F33657-70-C-0800.

Demonstration of the usability of low-void polyimides with quartz-reinforcement in the manufacture of large, thick-walled forward radomes for the B-1 aircraft. In addition to excellent electrical properties, these materials provide increased thermal resistance and electrical uniformity. Insertion phase delay measured for both half wave and full wave radomes showed a variation of less than two degrees from the target thickness when measured at Ku band. M.V.E.

A75-10925 * # Fretting in aircraft turbine engines. R. L. Johnson and R. C. Bill (NASA, Lewis Research Center, Cleveland, Ohio). *NATO, AGARD, Meeting of the Structures and Materials Panel, 39th, Munich, West Germany, Oct. 6-12, 1974, Paper.* 16 p. 15 refs.

Fretting usually produces both polished and pitted areas. Fretting occurs in connection with the relative motion between contacting surface elements. Particular attention is given to fretting in seals, splines, fans, compressors, and turbine blades. Recommended approaches to mitigate fretting problems include a reduction of the adhesion between two surfaces. Approaches for doing this may include the development of alloys which spontaneously generate a self-healing surface film, different in composition from the bulk alloy. Other fundamental adhesion studies have shown that surface crystal structure and crystallographic orientation significantly affect the adhesion properties of alloys. G.R.

A75-11045 A difference method for axisymmetric supersonic flow in rotating annular cascades with local subsonic regions (Ein Differenzenverfahren für die axialsymmetrische Überschallströmung in rotierenden Ringgittern mit lokalen Unterschallgebieten). H.-H. Frühauf. *Forschung im Ingenieurwesen*, vol. 40, no. 5, 1974, p. 145-152. 6 refs. In German.

The general equations of spatial flow in a rotating coordinate system are considered along with the equations of axisymmetric flow. Attention is given to the flow planes, the kinematics of axisymmetric flow, the continuity equation, and the equations of motion. A characteristics method is considered, taking into account the compatibility conditions. The obtained relations are simplified by introducing curvilinear coordinates. The resulting system of partial differential equations can be numerically solved with the aid of an explicit difference method. Initial and boundary values are considered along with the application of the described approach in a specific example. G.R.

A75-11046 Performance limitation of a hypersonic ramjet engine due to reaction kinetics (Die reaktionskinetische Leistungsbegrenzung des Hyperschallstautriebwerks). J. Algermissen and M. Natter. *Forschung im Ingenieurwesen*, vol. 40, no. 5, 1974, p. 153-162. In German.

A hypersonic ramjet engine could be used for the propulsion of vehicles in the flight Mach number range from 4 to 20. Aspects of reaction kinetics can be an important factor in the limitation of engine performance during the flight at high altitudes. An investigation is, therefore, conducted regarding the effect of reaction kinetics on the operational processes taking place in the engine. The investigation makes use of a simplified computational model, taking into account a hydrogen propulsion unit with variable geometric entrance conditions. Particular attention is given to the degree of performance reduction of the propulsion system as a function of flight altitude and Mach number. G.R.

A75-11083 # Noise and atmospheric emissions - An airline view. W. H. S. Bird (Air Canada, Montreal, Canada). (*Canadian Aeronautics and Space Institute and American Institute of Aeronautics and Astronautics, Joint Meeting, Montreal, Canada, Oct. 30, 1973.*) *Canadian Aeronautics and Space Journal*, vol. 20, June 1974, p. 293-302. 8 refs.

Engineering achievements are reviewed which have resulted in the development of appreciably quieter nacelles and engines currently fitted in latest commercial aircraft. A number of operational methods of reducing the total energy consumption are outlined. The airlines welcome these developments, but have serious misgivings concerning the adoption of a nacelle retrofit program or the early retirement of a great number of economically viable aircraft, to which the may be forced. Further misgivings concern the rationality of emission control standards, which will produce a miniscule reduction in total atmospheric pollution at an enormous financial outlay. V.P.

A75-11084 # Comment on 'Investigation of multi-element airfoils with external flow jet flap' by F. Mavriplis. D. J. Moorhouse (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *Canadian Aeronautics and Space Journal*, vol. 20, June 1974, p. 303-305. 6 refs.

A75-11085 # The externally-blown jet flap - A powered-lift concept for STOL. R. H. Wickens (National Aeronautical Establishment, Ottawa, Canada). *Canadian Aeronautics and Space Journal*, vol. 20, Sept. 1974, p. 323-340. 14 refs.

The aerodynamic characteristics of the Externally-Blown Jet Flap (EBF) are presented for wing configurations of the quasi 2-D and reflection-plane type respectively. Force and surface pressure measurements have shown that significant lift increments can be realized by external blowing, and that the spanwise effect of this increase extends outward from the nacelle location. The effective stream tube dimension of the additional lift can be a significant fraction of the wing span. The relationship between the quasi-2-D and 3-D polars has been shown to result from a rearward rotation of lift and drag through an induced incidence, which is due to the decrease in effective aspect ratio. Downstream flow surveys have shown that the presence of mixed regions of propulsive and vortex flows is typical of the EBF. Wake measurements downwind of a half-model of a multi-engined aircraft of the EBF type have shown that behind each half-wing, there are two trailing vortices, one from the wing tip, and one from the flap tip. (Author)

A75-11087 # Improved reliability of turbine engines through common sense maintenance. F. R. Cowley (United Aircraft of Canada, Ltd., Montreal, Canada). (*Canadian Aeronautics and Space Institute, Annual General Meeting, Ottawa, Canada, May 13, 1974.*) *Canadian Aeronautics and Space Journal*, vol. 20, Sept. 1974, p. 349-353.

The common-sense approach to turbine engine maintenance is briefly outlined. Improved reliability must start with the correct use of the engine; the use of the correct power available ensures satisfactory flight operations without abusing engine margins. Compressors should be kept clean by frequent washing. Both airframe and engine filters should be checked often for contamination. Engine starting temperatures should be monitored carefully. The careful recording of the day-to-day operating parameters of the engine will provide the ability to examine history and thus predict future maintenance actions that may be required. Good communications should always exist between flight and maintenance personnel.

P.T.H.

A75-11092 ATC implications of the 747 SP. T. K. Vickers (James C. Buckley, Inc., Washington, D.C.). *Journal of Air Traffic Control*, vol. 16, Sept.-Oct. 1974, p. 9-11.

This year Boeing is shrinking the 747 design to create a more compact, lighter, long-range wide-body transport, the 747 SP. The reduced size combined with the same engines as used in the standard 747 will result in some spectacular increases in performance for the new aircraft. Most of these increases will directly benefit the ATC system. On flights up to 3000 miles in length the SP will lift off in only 25 seconds. Other improvements include a shorter takeoff runway length, a higher climb rate, and a higher cruising altitude. The advantages of these improvements are discussed along with the effects the design changes could have on the alleviation of the trailing vortex problem. G.R.

A75-11094 # Pitch damping of helicopter rotor with non-uniform inflow. A. Azuma (Tokyo, University, Tokyo, Japan) and Y. Nakamura. *Journal of Aircraft*, vol. 11, Oct. 1974, p. 639-646. 12 refs.

Pitch or roll damping of helicopter rotor has been experimentally studied by using model rotors in rocking motion. The rotors have articulated blades with spring constrained hinges and different combinations of Lock number, flapping hinge offset, and hinge constrained stiffness. By considering nonuniform induced velocity distribution a theoretical estimation based on the momentum and blade element theory has shown good coincidence with the experimental results. In contrast with analyses based on the vortex theory the present theory is very simple and does not require complex calculations so that the analytic evaluation and the quick estimation of the dynamic stability derivatives of rotor will be possible. The blade flapping behavior during sinusoidal rocking motion has also been analytically and experimentally analyzed and the mechanism of generation of direct damping and cross coupling moments have been clearly explained. (Author)

A75-11095 # Some remarks on the solution of the lifting line equation. R. K. Bera (National Aeronautical Laboratory, Bangalore, India). *Journal of Aircraft*, vol. 11, Oct. 1974, p. 647, 648.

The present work offers a simplification in the solution of Prandtl's lifting line equation. The equation for the local circulation is usually solved using a sine series in a collocation method. Using the fact that local circulation and local geometric angle of attack are related by a linear operator, an expression can be obtained for the drag coefficient containing only the square of the unknown constants, which implies that the loadings are orthogonal in Graham's sense (1952). Expressions are derived for the unknown constants, making use of the orthogonality of the loadings. The solution gives an approximate solution along the entire span, so that discontinuities, flap deflections, etc., can be accounted for. P.T.H.

A75-11111 # A policy study of subsidized air service. W. M. Swan (MIT, Cambridge, Mass.). *Canadian Aeronautics and Space Institute and American Institute of Aeronautics and Astronautics, Joint Meeting, Toronto, Canada, Oct. 30, 31, 1974, AIAA Paper 74-1274*. 6 p. 8 refs.

A fleet assignment model which uses linear programming to maximize the cash income of an airline system is used to study the alternatives in providing air services in low density markets. Issues examined are: cost of using larger aircraft vs small turboprops; cost advantages of including the services in a larger network vs serving them independently; fuel costs in low-density vs high-density markets. (Author)

A75-11112 # Optimal competition in high density markets. P. J. Williams (Paul J. Williams and Associates, Bethesda, Md.). *Canadian Aeronautics and Space Institute and American Institute of Aeronautics and Astronautics, Joint Meeting, Toronto, Canada, Oct. 30, 31, 1974, AIAA Paper 74-1275.* 5 p.

Many high density markets are served by three or more carriers, and although this competition is intended to be for the benefit of the traveling public, it severely dilutes airline profits. A procedure has been developed to determine the effect of the number of carriers on both the quality of service and airline profits. The procedure is applied to three markets: Chicago-Los Angeles, Miami-New York, and Montreal-Toronto, and shows that, in the first two markets, the quality of service would improve if there were fewer competing carriers. (Author)

A75-11114 * # The rotor systems research aircraft - A flying wind tunnel. A. W. Linden and M. W. Hellyar (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). *Canadian Aeronautics and Space Institute and American Institute of Aeronautics and Astronautics, Joint Meeting, Toronto, Canada, Oct. 30, 31, 1974, AIAA Paper 74-1277.* 11 p. NASA-Army-supported research.

The Sikorsky Aircraft division of United Aircraft Corporation is constructing two uniquely designed Rotor Systems Research Aircraft (RSRA). These aircraft will be used through the 1980's to comparatively test many different types of rotors - articulated, hingeless, teetering, and gimbaled, as well as advanced rotor concepts, such as reverse velocity and variable diameter rotors. The RSRA combines a new airframe with existing Sikorsky H-3 (S-61) dynamic components. A force measurement system is incorporated to permit accurate evaluation of significant rotor characteristics. Both rotor and fixed-wing control systems are provided, appropriately integrated for operation in the pure helicopter mode, compound helicopter mode, and fixed-wing mode. The RSRA is the first rotary wing aircraft designed with a crew escape system, including a pyrotechnic system to sever the main rotor blades. (Author)

A75-11115 # YC-14 system for leading edge boundary layer control. H. L. Ernst and A. Gupta (Boeing Co., Seattle, Wash.). *Canadian Aeronautics and Space Institute and American Institute of Aeronautics and Astronautics, Joint Meeting, Toronto, Canada, Oct. 30, 31, 1974, AIAA Paper 74-1278.* 8 p. 8 refs.

A high-lift leading edge boundary layer control (BLC) system is an integral part of the design of the YC-14 prototype airplane. The system is based on the concept of 'blowing' and uses bleed air from the 8th and 14th stages of the high pressure compressor of the main engine. Air from the two sources is mixed in a fixed-geometry ejector to provide the necessary blowing. Automatic control permits the BLC system to select its own operating mode (takeoff or landing) and to accommodate all engine and engine-out maneuvers. A unique status-monitoring approach is used to track system performance capability and ensure availability of design blowing momentum for low-speed maneuver if an engine fails. This paper synthesizes the considerations that led to selection of the BLC system design concept, system components, and control methods, and discusses significant component development tests and fabrication studies that were performed. (Author)

A75-11116 * # LTA in the USA - Here's where it stands today. J. F. Vittek, Jr. (MIT, Cambridge, Mass.). *Canadian Aeronautics and Space Institute and American Institute of Aeronautics and Astronautics, Joint Meeting, Toronto, Canada, Oct. 30, 31, 1974, AIAA Paper 74-1280.* 10 p. Research supported by the U.S.

Department of Transportation, U.S. Navy, NASA, and FAA.

Lighter than air (LTA) vehicles were the first aircraft to fly and, until the disasters of the 1930s, were thought by many to be the primary mode of air transport. The history of LTA in the United States is briefly traced and the reasons for the current revival in interest are discussed. The focal point for this revival was the LTA Workshop hosted by M.I.T. under the joint sponsorship of the United States National Aeronautics and Space Administration, Navy, Federal Aviation Administration and Department of Transportation. The Workshop and its results are discussed in detail. (Author)

A75-11121 # Application of methods of abstract algebra to the synthesis of an automatic system for controlling the longitudinal motion of an aircraft (Primenenie metodov abstraktnoi algebry dlia sinteza sistemy avtomaticheskogo upravleniia prodol'nym dvizheniem samoleta). V. V. Udilov and G. T. Kovbasa (Akademiia Nauk Ukrainskoi SSR, Institut Kibernetiki, Kiev, Ukrainian SSR). *Kibernetika i Vychislitel'naia Tekhnika*, no. 23, 1974, p. 28-33. 6 refs. In Russian.

The problem of reducing the analysis and synthesis problem for an automatic control system with many inputs to several problems for a number of independent subsystems with one input is discussed. It is shown that a possible method of solution is to study the system as an invariant of a semisimple algebra of linear transformations in state space (input-output states, or input states). The application of this approach to the automatic control of the longitudinal motion of an aircraft is demonstrated. The stability conditions for the subsystems are obtained in the form of linear inequalities between the control gains. V.P.

A75-11151 Aerodynamic torques on rotating oblate spheroids. P. R. Kry and R. List (Toronto, University, Toronto, Canada). *Physics of Fluids*, vol. 17, June 1974, p. 1087-1092. 8 refs. Research supported by the National Research Council of Canada.

Aerodynamic torques about the vertical major axis of each of three rotating oblate spheroids with smooth surfaces were measured in a horizontal wind tunnel as a function of Reynolds number and rotation rate. Rotations were either about the vertical axis or the minor axis which was held inclined to the mean air flow at several fixed angles. Spin about a minor axis only shifted critical Reynolds numbers to lower values. Spin rates corresponding to Strouhal numbers less than 0.1 at Reynolds numbers less than 150,000 had no effect on the aerodynamic restoring torque. Each of the three spheroids autorotated at frequencies with Strouhal numbers of approximately 0.15. For rotations at Strouhal numbers less than 0.04, the average nonconservative torque was less than 10% of the maximum static torque. Hence, these experiments establish the range of applicability of a quasistatic approximation for the aerodynamic torques on smooth oblate spheroids. (Author)

A75-11235 Variational-difference method of studying the stressed state of the rim of the turbine disk in a T-shaped tail joint. E. D. Konson and A. I. Omel'chak (Leningradskii Metallicheski Zavod, Leningrad, USSR). (*Problemy Prochnosti*, vol. 5, Dec. 1973, p. 75-80.) *Strength of Materials*, vol. 5, no. 12, Sept. 1974, p. 1503-1509. 8 refs. Translation.

A75-11278 # A critique of the F-14A air inlet control system - From development to production status. H. Huttenlocher, R. Steele (Grumman Aerospace Corp., Bethpage, N.Y.), C. Thomson (U.S. Navy, NAVAIR Propulsion Div., Washington, D.C.), and B. Mellinger (AiResearch Manufacturing Co., Torrance, Calif.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1060.* 10 p.

The F-14A air inlet control system (AICS) is reviewed for configuration and functional performance from the flight development phase through the first five lots of 134 production aircraft. The

text is control system oriented, and discusses four phases of the AICS history. The first phase deals with the critique of the flight development configuration which enabled pilot's manual control of inlet duct parameters and includes flight test safety overrides and readouts. The second phase discusses the operational performance of the present production aircraft system in technical areas such as reliability, maintainability, accuracy, fail safe provisions, and built-in-test capability. The third phase deals in depth with the unpredicted technical integration problems encountered during the development and production periods. The final phase deals with the consideration of logical product improvement tradeoff results for future air inlet control systems. (Author)

A75-11279 # YF-16 inlet design and performance. J. E. Hawkins (General Dynamics Corp., Fort Worth, Tex.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1062.* 12 p. Contract No. F33657-72-C-0702.

The YF-16 inlet design, integration of airframe and inlet, design philosophy, development tests, and performance of the inlet throughout the flight and maneuver envelope of the airplane are reviewed. Model data are included which show the airplane forebody effect on the inlet flow field and show the performance of the inlet in terms of pressure recovery, distortion, turbulence, inlet stability, and spillage drag. Also, wind-tunnel model and flight-test engine-face pressures are compared. The data presented verify that the single, fixed-geometry, normal-shock inlet located in the protective flow field of the fuselage nose provides an integrated inlet/airframe configuration that meets all design and performance goals. The simple, low-cost, and uncomplicated inlet design optimizes rather than compromises airplane performance in the air-combat arena and at the same time provides a Mach 2 capability for the airplane. (Author)

A75-11280 # Electronic propulsion controls for commercial aircraft. P. W. Kamber and A. D. Welliver (Boeing Commercial Airplane Co., Renton, Wash.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1065.* 7 p.

Boeing studies indicate that electronic propulsion control constitutes an economically desirable choice for commercial transports. Benefits (e.g., improved engine life, freeing pilots' time for better use, control coordination with aircraft systems) are expected from computing powers and high accuracy of full-authority digital control dedicated to individual engines. It is suggested that operators' airworthiness, dispatch, and maintenance requirements will be met. A comparison of various control arrangements is presented. Starting with a review of current electronic supplements to hydromechanical controls, it follows the evolution to future systems which afford supervisory or full-authority control to electronics. A current development program is described. (Author)

A75-11297 # F-15 flight test experience with the F100-PW-100 engine. D. Hamer (McDonnell Aircraft Co., St. Louis, Mo.) and G. Ballard (United Aircraft Corp., Pratt and Whitney Aircraft Div., West Palm Beach, Fla.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1162.* 11 p.

The F-15 aircraft, with P & WA F100 engines, has completed over 2 years of flight test development. Development and demonstration of the propulsion system has been a significant part of this program. In this paper flight development of the F100 engine is discussed. Propulsion system instrumentation, data acquisition and reduction are described. Up-to-date flight test results of F100 engine operation in the F-15 are given in the areas of steady-state and transient performance, airstarting, and inlet/engine compatibility. (Author)

A75-11298 # Recent flight experience with the F100 engine in the YF-16. F. G. Hatt and D. M. Hancock (General Dynamics Corp., Fort Worth, Tex.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1163.* 14 p.

Success of the YF-16 flight program conducted in an austere budget environment, can be attributed partly to the outstanding performance of the propulsion system. The Pratt and Whitney Aircraft F100-PW-100 engine operated satisfactorily throughout the flight envelope. Although the scope of the inflight measurements was limited by cost, sufficient data were acquired for monitoring engine operation and for input to the Air Force's Uniform Flight Test Analysis System (UFTAS). Concise programming of engine cycle and inflight thrust computation procedures (PROP) permitted the incorporation of PROP into UFTAS and, thus, the reduction of propulsion data with minimal effort. The test and predicted thrust data show agreement from the standpoint of flight test computations, engine predictions, test stand measurements, and airplane drag predictions. (Author)

A75-11299 * # Performance of a model cascade thrust reverser for short-haul applications. D. A. Dietrich and O. A. Gutierrez (NASA, Lewis Research Center, V/STOL and Noise Div., Cleveland, Ohio). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1171.* 41 p. 9 refs.

Aerodynamic and acoustic characteristics are presented for a cowl-mounted, model cascade thrust reverser suitable for short-haul aircraft. Thrust reverser efficiency and the influence on fan performance were determined from isolated fan-driven models under static and forward velocity conditions. Cascade reverser noise characteristics were determined statically in an isolated pipe-flow test, while aerodynamic installation effects were determined with a wind-tunnel, fan-powered airplane model. Application of test results to short-haul aircraft calculations demonstrate that such a cascade thrust reverser may be able to meet both the performance and noise requirements for short-haul aircraft operation. However, aircraft installation effects can be quite significant. (Author)

A75-11300 # The LTS 101 600 SHP engine. H. F. Grady (Avco Corp., Avco Lycoming Div., Stratford, Conn.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1187.* 6 p.

This paper traces the development history of the Lycoming LTS 101 engine, from initial design and configuration studies, through the current Type Certification program. The background of earlier engine and component developments in the 5 lb/sec class is summarized. A synthesis of the initial configuration and cycle studies is presented in terms of the fundamental design targets of low cost and improved fuel consumption. Performance and cost summaries are given together with a detail engine description. Derivative versions of the basic LTS 101 design are discussed and a program update is summarized. (Author)

A75-11301 * # Flight-test techniques for obtaining valid comparisons of wind-tunnel and flight results from tests on a YF-12 mixed-compression inlet. P. J. Reukauf, W. G. Schweikhard, and H. Arnaiz (NASA, Flight Research Center, Edwards, Calif.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1195.* 14 p. 5 refs.

A75-11371 # Viper turbojet engines. II (Turbinowe silniki odrzutowe Viper. II). W. Kordzinski. *Technika Lotnicza i Astronautyczna*, vol. 29, Aug. 1974, p. 7-12, 15. In Polish.

Description of the design and technical features of series 500 and 600 Viper turbojet engines manufactured by Rolls-Royce Ltd. The engines in question have an eight-stage compressor and an

annular combustion chamber with fuel vaporizers. The engine turbine is single-stage in the case of the series 500 and two-stage in the case of the series 600. The company's plans for further development of the Viper family are discussed, an analysis is made of the range of applications of currently produced and future Viper engines, and problems connected with their operation are cited. The factors contributing to the success of the engines - i.e., their consistent development and simplicity of design - are emphasized.

A.B.K.

A75-11372 # Certain problems of fuel consumption in air transport (Niektóre problemy zużycia paliw w transporcie lotniczym). K. Rzemek. *Technika Lotnicza i Astronautyczna*, vol. 29, Aug. 1974, p. 13-15. In Polish.

Review of the unit kilometer fuel consumption characteristics, and determination of the limits of optimal utilization of aircraft with a view to maximization of available transport capacity. Tables and diagrams are presented which make it possible to compare various types of aircraft from the standpoint of unit consumption of fuel per ton-kilometer as a function of route sections in operation and to determine the optimal routes on which operation of the Il-62, the Il-18, the Tu-134, the An-24, the DC-9-50, and the DC-10 is justified.

A.B.K.

A75-11373 # Steam rockets for takeoff (Parowe rakiety startowe). H. Schwach. *Technika Lotnicza i Astronautyczna*, vol. 29, Aug. 1974, p. 16, 17, 40. In Polish.

Description of the characteristics and principle of operation of an auxiliary takeoff device called the pulsed overheated water rocket. The device in question is a steam rocket with a programmed thrust designed to shorten the takeoff run of an aircraft. It is shown that this device is capable of reducing by half the required takeoff run of certain types of aircraft. A rocket of this type with a maximum thrust of 4000 kg was successfully employed on a French Mirage III fighter plane.

A.B.K.

A75-11375 # Practical application of the Howard-Czencow method - Calculation of bent and axially compressed beams. II (Praktyczne zastosowanie metody Howarda-Czencowa - Obliczanie belek zginanych i osiowo sciskanych. II). S. Lassota. *Technika Lotnicza i Astronautyczna*, vol. 29, Aug. 1974, p. 28-34. In Polish.

Description of a method which makes possible rapid and easy solution of certain problems involving rods or beams which are simultaneously compressed and placed under a bending load. It is shown how the Howard-Czencow method can be used in the plotting of polar diagrams for beams under simultaneous compressive and bending loads, with particular attention being paid to the case of a constant moment of inertia of the beam cross section and continuous loading which varies along the beam span and to the case of constant continuous loading and variable moment of inertia along the beam span.

A.B.K.

A75-11426 Next generation transports will emphasize fuel savings. *Aviation Week and Space Technology*, vol. 101, Oct. 28, 1974, p. 48, 49, 51.

Technology for the minimum energy airplane is reviewed. Special attention is given to an advanced medium-range aircraft that is being developed to lower fuel economics and twin-engine airplanes are considered that will incorporate new wing and structures technology. Improvements in aircraft design include (1) a long duct and thin wall nacelles, (2) the use of aluminum and titanium alloys for reduced stress corrosion and weight and high fatigue life, and (3) advanced airfoils and high lift devices. New concepts for the minimum energy airplane that would embody composites or improve skin and stringer techniques are included.

T.S.

A75-11427 Fuel outlook dictating technical transport research. W. C. Wetmore. *Aviation Week and Space Technology*, vol. 101, Oct. 28, 1974, p. 52, 53 (3 ff.).

Technical research priorities for air transport are reviewed. NASA, in its study of energy-efficient aircraft technology, is predicting the use of alternative fuels such as liquefied hydrogen for certain fuel-conservative aircrafts. Other aerodynamic developments including use of a wingtop vortex diffuser, a laminar flow control technique to be applied to the wings and tail surfaces, the idea of a compliant skin-aircraft, and a span-distributed load concept for reducing fuel consumption are discussed.

T.S.

A75-11577 # Fundamental geometric and aerodynamic characteristics of aircraft and finned rockets (Osnovnye geometricheskie i aerodinamicheskie kharakteristiki samoletov i krylatykh raket). V. G. Mikeladze and V. M. Titov. Moscow, Izdatel'stvo Mashinostroenie, 1974. 152 p. 16 refs. In Russian.

The present work gives succinct definitions and symbols for the main geometric and aerodynamic parameters of aircraft and finned rockets as established by revised Soviet standards. Symbols and coordinate systems as recommended by the International Organization for Standardization are also given for comparison. Among the main geometric parameters are included: span of the lifting surface (wing), chords of the wing, angle of a swept wing, area of the wing surface, area of stabilizing and control surfaces, and the deflection angle of the rudder, ailerons, flaps, and stabilizers. Among the main aerodynamic characteristics are included: the dependence of the lift and drag coefficients and the coefficients of aerodynamic moments and hinge moments on Mach number, Reynolds number, angle of attack, glide angle, and the deflection angle of the control and stabilizing surfaces.

P.T.H.

A75-11624 * Automated structural design with aeroelastic constraints - A review and assessment of the state of the art. W. J. Stroud (NASA, Langley Research Center, Hampton, Va.). In: Structural Optimization Symposium, New York, N.Y., November 17-21, 1974, Proceedings. New York, American Society of Mechanical Engineers, 1974, p. 77-118. 69 refs.

A review and assessment of the state of the art in automated aeroelastic design is presented. Most of the aeroelastic design studies appearing in the literature deal with flutter, and, therefore, this paper also concentrates on flutter. The flutter design problem is divided into three cases: as isolated flutter mode, neighboring flutter modes, and a hump mode which can rise and cause a sudden, discontinuous change in the flutter velocity. Synthesis procedures are presented in terms of techniques that are appropriate for problems of various levels of difficulty. Current trends, which should result in more efficient, powerful and versatile design codes, are discussed. Approximate analysis procedures and the need for simultaneous consideration of multiple design requirements are emphasized. (Author)

A75-11626 * On computer-aided design of aerospace vehicles. J. E. Sobieszcanski, S. J. Voigt, and R. E. Fulton (NASA, Langley Research Center, Hampton, Va.). In: Structural Optimization Symposium, New York, N.Y., November 17-21, 1974, Proceedings. New York, American Society of Mechanical Engineers, 1974, p. 135-160. 23 refs.

Digital computers are being used in many engineering activities to support design work. This paper provides an overview of some of this work as it relates to the design of aerospace vehicles. Discussions are given of some of the complexities of the design process which lead to large design costs and time. A number of important but disjointed computer capabilities have evolved over the years in analysis, optimization, and graphics, and such capabilities aid in addressing the problem of design complexity. Examples of existing computer-aided design (CAD) systems are given and trends for future CAD systems are indicated, as well as their relationship to pertinent data management technology. It is suggested that major gains in design capability will occur through continued development of CAD methodology and that these gains may be accelerated through a large focused effort.

(Author)

A75-11639 Atmospheric ozone and its influence on the operation of supersonic transport. G. P. Gushchin, V. V. Osechkin, and S. V. Solonin. In: Actinometry, atmospheric optics, ozonometry. Jerusalem, Israel Program for Scientific Translations, 1974, p. 127-140. 33 refs. Translation.

Atmospheric-ozone investigations conducted during the last 15 years are reported. Patterns of horizontal and vertical distribution of ozone in the earth's atmosphere are discussed, as well as the connection between the total ozone content and meteorological conditions. The effect of ozone on the operation of modern turbojet aircraft is analyzed, and the need is stressed for studying the influence of ozone in flight scheduling and in SST operation.

(Author)

A75-11641 Preliminary test results of the 'oblique ray' installation. E. N. Dovgiallo and V. A. Kovalev. In: Actinometry, atmospheric optics, ozonometry. Jerusalem, Israel Program for Scientific Translations, 1974, p. 148-153. 8 refs. Translation.

The paper reports on tests of an experimental setup for measuring the oblique transmission of the atmosphere. The tests were carried out in fall 1970-winter 1971 on the photometric proving grounds at Voeikovo. A commercial RDV-2 transmission recorder, with reflector positioned on the tower of an SBK-1 crane, was used as standard instrument, with which the readings of the investigated backscatter setup were compared. Atmospheric transmission was measured at an angle of 12 deg inclination to the horizon, the length of the oblique measurement trajectory being 150 m. The coefficient of correlation between the readings of the standard instrument and those of the backscatter setup being tested was approximately 0.8.

(Author)

A75-11653 # Stabilization of the longitudinal motion of a flight vehicle in the presence of a delay in the control forces (O stabilizatsii prodol'nogo dvizheniia letatel'nogo apparata pri nalichii zapazdyvaniia v upravliaiushchikh silakh). T. M. Chikhladze (Universitet Druzhby Narodov, Moscow, USSR). *Akademiia Nauk Gruzinskoi SSR, Soobshcheniia*, vol. 75, Aug. 1974, p. 425-428. In Russian.

Derivation of a sufficient condition of absolute stability of the longitudinal motion of a flight vehicle in the case where the control force acts on the vehicle with a certain delay. To obtain the desired condition, the Liapunov vector function method is employed in a form applicable to systems with a time lag. In accordance with the procedure for obtaining a condition of stability in the large developed by Piontkovskii and Chikhladze (1973), a third-order system with a time lag is replaced by a $(3 + n)$ -th order system of ordinary differential equations, of which the $(n + 1)$ -th subsystem is subsequently considered.

A.B.K.

A75-11672 Stress and vibration analysis with the aid of models; Meeting, Stuttgart, West Germany, October 4, 5, 1973, Reports (Spannungs- und Schwingungsanalyse mit Hilfe von Modellen; Tagung, Stuttgart, West Germany, October 4, 5, 1973, Vorträge). Meeting sponsored by the Verein Deutscher Ingenieure and Verein Deutscher Elektrotechniker. *VDI-Berichte*, no. 197, 1974. 136 p. In German.

Basic considerations regarding the employment of models are discussed along with the use of a model in a study of fundamental oscillation parameters, applications of similarity laws in the case of turbomachines, the determination of thermal stresses on models, vibrational investigations on aircraft models in support of flutter calculations, and the experimental determination of the effect of frictional stresses on elastically supported plates. Other subjects considered are related to the state of development of photoplasticity, the application of holography to photoelasticity, and model studies with a computer.

G.R.

A75-11673 Investigations involving a 'dynamically similar' component model of the VFW 614 - Experimental determination of the fundamental oscillation parameters (Untersuchungen an einem 'dynamisch ähnlichen' Teilmodell der VFW 614 - Versuchsmässige Ermittlung der Eigenschwingungsgrössen). E. Dellinger. (Verein Deutscher Ingenieure und Verein Deutscher Elektrotechniker, Tagung über Spannungs- und Schwingungsanalyse mit Hilfe von Modellen, Stuttgart, West Germany, Oct. 4, 5, 1973.) *VDI-Berichte*, no. 197, 1974, p. 15-23. In German.

The model considered can be used in a comparative evaluation with dynamic-response calculations for the wing-pylon system. The calculations are conducted to determine on the basis of the elastomechanical parameters the structural responses to certain exterior forces. The model has to satisfy requirements concerning dynamic similarity in vacuo for wing, pylon, and connections. The model must also meet specifications regarding mass and moment of inertia relations for the propulsion system and the other components of the aircraft. A static vibration test was conducted to determine the critical parameters of the undamped system and effective damping values in the case of the damped system.

G.R.

A75-11674 Applications of similarity laws in the case of turbomachines (Anwendungen der Ähnlichkeitsgesetze bei Turbomaschinen). E. Pollmann. (Verein Deutscher Ingenieure und Verein Deutscher Elektrotechniker, Tagung über Spannungs- und Schwingungsanalyse mit Hilfe von Modellen, Stuttgart, West Germany, Oct. 4, 5, 1973.) *VDI-Berichte*, no. 197, 1974, p. 25-32. In German.

The concept of geometric similarity is considered along with the most important dynamic and thermal similarity laws. Attention is given to similarity conditions for flows in multistage machines, the stresses to which the blade material and the rotor are subjected, and the similarity conditions for the bearings. Applications of thermal similarity concepts described are related to the determination of thermal stresses and the investigation of the heating processes which take place in the structural components.

G.R.

A75-11676 Vibrational investigations on aircraft models in support of flutter calculations (Schwingungsuntersuchungen an Flugzeugmodellen zur Unterstützung der Flatterrechnung). J. Schoen. (Verein Deutscher Ingenieure und Verein Deutscher Elektrotechniker, Tagung über Spannungs- und Schwingungsanalyse mit Hilfe von Modellen, Stuttgart, West Germany, Oct. 4, 5, 1973.) *VDI-Berichte*, no. 197, 1974, p. 51-59. In German.

Practical experience has shown that there is a very high risk of errors in an approach which relies for the determination of flutter characteristics solely on a computational determination of the critical parameters. The use of an approach which combines experimental investigations with the calculations is, therefore, to be preferred. Suitably designed flutter models are tested in the wind tunnel at an early design stage of the aircraft. It is pointed out that it is not intended to make the calculations unnecessary. The model tests are to provide a verification of the computational results. Another objective of the tests is to obtain physically realistic assumptions as basis for the calculations. Questions of flutter model technology are discussed along with the characteristics of models for the low-velocity range, problems with high-velocity models, and advanced investigative techniques of recent origin.

G.R.

A75-11720 The 1973 program of measurement of the minor constituents of the stratosphere using the Concorde 001 (Campagne 1973 de mesures des constituants mineurs dans la stratosphère par Concorde 001). M. Ackerman (Institut d'Aéronomie Spatiale de Belgique, Brussels, Belgium) and R. Joatton (Société Nationale Industrielle Aérospatiale, Paris, France). *L'Aéronautique et l'Astronautique*, no. 47, 1974, p. 15-22. 10 refs. In French.

Review of the genesis, definition, and performance of the 1973

program of measurement of the rare (NO, NO₂, SO₂, CH₄, HCHO, and HNO₃) constituents of the stratosphere using infrared spectroscopy on 12 specially planned flights of the Concorde 001. The obtained data have made possible the validation of some models predicting the condition of the stratosphere after a few decades of contamination by pollutants. M.V.E.

A75-11721 The American STAGG gas generator program (Le programme américain de générateur de gaz STAGG). A. Bodemer (Centre de Documentation de l'Armement, Paris, France). *L'Aéronautique et l'Astronautique*, no. 47, 1974, p. 23-25. In French.

Brief outline of the ongoing U.S. Army small turbine advanced gas generator (STAGG) study and development program started in 1965. Special attention is given to the four engines presently in the process of development, namely, the 180-, 155-, 610-, and 410-kW engines proposed by AiResearch-Garret, Williams, Lycoming, and Pratt and Whitney, respectively. M.V.E.

A75-11722 The SA. 360 'Dauphin' - Definition and development (Le SA. 360 'Dauphin' - Définition et mise au point). R. Mouille (Société Nationale Industrielle Aérospatiale, Marignane, Bouches-du-Rhône, France). *L'Aéronautique et l'Astronautique*, no. 47, 1974, p. 27-37. In French.

The SA. 360 helicopter has been designed as the modern successor of the 'Alouette III'. Although not much bigger in size, it can normally carry ten people, owing to its substantially increased carrying space. The aircraft is fitted with a Turbomeca 'Astazou XVIII' engine, rated at 1046 CV (1031 HP), a main rotor with four glass/carbon/resin composite blades and a shrouded tail rotor of the type mounted on 'Gazelle'. At a gross weight of 2800 kg (6173 lb), it reaches high performance both in hover and level flight in which operating speeds are up to 300 km per hour (162 knots), with a very good vibration level. The overall design chosen led to simple solutions for transmission and structural components. The three-wheeled landing gear with a tail wheel well integrated into the 'Fenestron' tail unit makes extreme tail-down landings possible. During the design stage, particular emphasis was put on reliability with a view to reducing maintenance costs to a minimum. (Author)

A75-11724 An inexpensive jet engine, dream or reality (Le réacteur bon marché, rêve ou réalité). Mr. Faury (Société d'Innovation et de Développement en Aérothermodynamique, Toulouse, France). *L'Aéronautique et l'Astronautique*, no. 47, 1974, p. 82-84. In French.

Discussion of the development of an expendable, short-lived jet engine of utmost design simplicity and suitable for mass production by processes of moderate tooling requirements, intended for the propulsion of remotely piloted vehicles for ground or sea attack, reconnaissance, illumination, decoy, interference, and target practice missions. A brief description of the French TRI 60 jet engine is presented. M.V.E.

A75-11739 High-performance centrifugal compressors (Compresseurs centrifuges à hautes performances). J. M. Merigoux (CIT-ALCATEL, Bruyères-le-Châtel, Essonne, France). *Entropie*, vol. 10, May-June 1974, p. 32-40. 5 refs. In French.

The present work sketches the fundamental design questions concerning the various elements of high-performance centrifugal compressors and indicates possible approaches to the optimization of the performance of each element in order that centrifugal compressors be realized with efficiency comparable to that of axial compressors. A general picture of the aerodynamic flow through a whole compressor is obtained by studying factors controlling the flow at each element of a compressor stage. The functions of each element (inlet guide vanes, inducer, impeller, space between the impeller and the diffuser, diffuser) are analyzed, and some recent results in their study are summarized. P.T.H.

A75-11895 # A conceptual approach to applying singular perturbation methods to variational problems. A. J. Calise and R. Aggarwal (Dynamics Research Corp., Wilmington, Mass.). In: Annual Allerton Conference on Circuit and System Theory, 11th, Monticello, Ill., October 3-5, 1973, Proceedings. Urbana, University of Illinois, 1974, p. 693-702. 6 refs.

The approach considered is based on a multiple time-scale separation of the state equations and on an enforcement of the requirement that the Hamiltonian be continuous across the separate boundary layers. An investigation is conducted regarding optimal aircraft control for delivering an air-to-air missile, giving attention to a two-dimensional singular perturbation solution, a free stream solution, and a first boundary-layer solution. G.R.

A75-12060 Influence of inherent carrier motion on a frequency selection system. Iu. A. Lavrent'ev. (*Radiotekhnika*, vol. 28, Dec. 1973, p. 5-9.) *Telecommunications and Radio Engineering, Part II - Radio Engineering*, vol. 28, Dec. 1973, p. 59-62. Translation.

A75-12077 Resolving the contradictions between airplane component weight and drag. V. P. Gogolin. (*Aviatsionnaia Tekhnika*, vol. 17, no. 1, 1974, p. 13-16.) *Soviet Aeronautics*, vol. 17, no. 1, 1974, p. 8-11. Translation.

A75-12078 Calculation of the aerodynamic characteristics of a system of rectangular wings moving near a screening surface. S. D. Ermolenko, Iu. A. Rogozin, and G. V. Rogachev. (*Aviatsionnaia Tekhnika*, vol. 17, no. 1, 1974, p. 17-22.) *Soviet Aeronautics*, vol. 17, no. 1, 1974, p. 12-16. Translation.

A75-12087 Calculation of helicopter main rotor blade deformation with account for control flexibility. A. Iu. Liss. (*Aviatsionnaia Tekhnika*, vol. 17, no. 1, 1974, p. 64-71.) *Soviet Aeronautics*, vol. 17, no. 1, 1974, p. 54-60. 7 refs. Translation.

A75-12088 Analysis of multihinge tailplane with account for control surface deflection. V. A. Pavlov. (*Aviatsionnaia Tekhnika*, vol. 17, no. 1, 1974, p. 72-76.) *Soviet Aeronautics*, vol. 17, no. 1, 1974, p. 61-65. Translation.

A75-12096 Experimental study of spanwise air jet influence on wing aerodynamic characteristics. Z. Kh. Nugmanov. (*Aviatsionnaia Tekhnika*, vol. 17, no. 1, 1974, p. 122, 123.) *Soviet Aeronautics*, vol. 17, no. 1, 1974, p. 101, 102. Translation.

A75-12098 Influence of airplane structural elasticity on flight safety and comfort in turbulent atmosphere. V. Z. Shestakov. (*Aviatsionnaia Tekhnika*, vol. 17, no. 1, 1974, p. 130-133.) *Soviet Aeronautics*, vol. 17, no. 1, 1974, p. 109-112. Translation.

A75-12106 Effect of erosive wear on aircraft gas turbine engine axial compressor cantilever blade endurance. V. M. Kapralov. (*Aviatsionnaia Tekhnika*, vol. 17, no. 1, 1974, p. 160-162.) *Soviet Aeronautics*, vol. 17, no. 1, 1974, p. 142-144. Translation.

A75-12122 A new look at qualification of aircraft equipment. P. Angelus (Douglas Aircraft Co., Long Beach, Calif.). (*Institute of Environmental Sciences, Annual Technical Meeting, 20th, Washington, D.C., Apr. 28-May 1, 1974.*) *Journal of Environmental Sciences*, vol. 17, Sept.-Oct. 1974, p. 11-15.

The two categories of fully documented qualification testing in the aviation industry include structure testing and the testing of various subsystems and individual equipment. Tests of the second

category are conducted by the suppliers to study the ability of the equipment to provide trouble-free operation over a given lifespan. Questions concerning the status of government standards are considered along with problems related to the high cost of qualification testing, reasons for reexamining current practices, a definition of cost effectiveness, approaches for establishing the requirements for future programs, and aspects concerning the use of statistical concepts. G.R.

A75-12125 Reliability and maintainability of aircraft jet engines. II (Fiabilité et maintenabilité sur les réacteurs aéronautiques. II). A. Mihail (Centre de Documentation de l'Armement; Bureau Veritas, Paris, France). *AFCIQ, Bulletin*, vol. 10, Sept. 1974, p. 12-19. In French.

The present work discusses some of the economic considerations, in terms of both time and cost, of approaches to continuous jet engine condition monitoring. A manual approach consists in having the crew itself make rough calculations of the deviation of engine condition from a standard on the basis of in-flight readings. This system is simple and has the advantage of being conducted in real time. Its disadvantages lie in that it is not exactly continuous, is difficult for a two-man crew, and requires additional ability of the crew members to interpret the results. An operational approach consists in recording of data for ground processing by computer. This permits more exact evaluation but not in real time. It is also more costly. P.T.H.

A75-12188 A case study of ultra high rate of wear experienced in a gear tooth flank. P. B. Macpherson (Westland Helicopters, Ltd., Yeovil, Somerset; Imperial College of Science and Technology, London, England). *American Society of Lubrication Engineers and American Society of Mechanical Engineers, Joint Lubrication Conference, Montreal, Canada, Oct. 8-10, 1974, ASLE Preprint 74LC-6B-2*. 5 p. Members, \$1.50; nonmembers, \$3.00.

Experience of EP oils used in spiral bevel and simulated disk machine work showed clearly that a high rate of surface wear could result from running under certain conditions. A research oil was formulated which prevented wear under these operating conditions and was used most successfully in helicopter gearboxes for both research and development overload testing. This research oil was used for testing conformal gears which are novel to the helicopter industry. Following satisfactory initial testing, inadvertent overloading resulted in severe scuffing. Further testing with a new gear pair led to the most severe case of wear rate either experienced or known to the author. This form of scuffing, which produces an extremely high wear rate, has been investigated in some detail using both the damaged gears and disk machine specimens. (Author)

A75-12197 * # Mainshaft seals for small gas turbine engines. L. P. Ludwig (NASA, Lewis Research Center, Cleveland, Ohio) and P. Lynwander (Avco Corp., Lycoming Div., Stratford, Conn.). *American Society of Lubrication Engineers and American Society of Mechanical Engineers, Joint Lubrication Conference, Montreal, Canada, Oct. 8-10, 1974, ASLE Preprint 74LC-1C-2*. 12 p. 9 refs. Members, \$1.50; nonmembers, \$3.00. Army-supported research; Contract No. NAS3-16720.

An experimental evaluation of mainshaft seals for small gas turbine engines was conducted with shaft speeds to 213 m/sec, air pressures to 215 psia, and air temperatures to 412 K. A radial face seal incorporating self-acting geometry for lift augmentation was evaluated. In addition, three conventional carbon seal types (face, circumferential segmented, and rotating ring) were run for comparison. Test results indicated that the conventional seals used in this evaluation may not be satisfactory in future advanced engines because of excessive air leakage. On the other hand, the self-acting face seal was shown to have the potential capability of limiting leakages to one-half that of the conventional face seals and one-fifth that of conventional ring seals. A 150 hour endurance test of the self-action face seal was conducted at speeds to 145 m/sec, air

pressures to 180 psia, and air temperatures to 408 K. The seal wear was not measurable. (Author)

A75-12246 * # Avionics systems in the management of air transportation. B. K. Berkstresser (NASA, Aeronautical Operating Systems Office, Washington, D.C.). *AIAA, DOT, and NASA, Life Sciences and Systems Conference, Arlington, Tex., Nov. 6-8, 1974, AIAA Paper 74-1294*. 8 p. 5 refs.

Aspects of aircraft operating systems technology are discussed along with the requirements of the National Airspace System and the system requirements for transport and light aircraft. Attention is given to problems regarding man's role as systems become increasingly complex. It is pointed out that science does not know enough concerning the operation of the human body to provide information for an optimal exploitation of man's unique capabilities as manager of his aircraft. G.R.

A75-12248 * # Flight management - Pilot procedures and system interfaces for the 1980-1990's. T. E. Wempe (NASA, Ames Research Center, Moffett Field, Calif.). *AIAA, DOT, and NASA, Life Sciences and Systems Conference, Arlington, Tex., Nov. 6-8, 1974, AIAA Paper 74-1297*. 8 p. 11 refs.

In the air transportation system of the 1980-1990's, aircraft must perform with greater precision in time and position than is possible today. Rapid development in electronics technology makes renovation in airborne-system concepts feasible. The Ames Research Center is conducting research on pilot procedures and pilot-system interfaces for such systems. Research on various pilot-system interface devices and manned simulations was conducted to study rules of distributed decision making authority among pilots and controllers with various airborne display concepts, and a pilot-oriented command logic for the control of avionic systems was studied. Results are summarized, and ongoing work and future research plans described. (Author)

A75-12329 # An elastic flight vehicle as an automatic control plant (Uprugii letatel'nyi apparat kak ob'ekt avtomaticheskogo upravleniia). K. S. Kolesnikov and V. Sukhov. Moscow, Izdatel'stvo Mashinostroenie, 1974. 268 p. 67 refs. In Russian.

Problems associated with the dynamics of flight vehicles operated by means of an automatic control system are discussed. A general approach to the solution of such problems is used for both aircraft and rockets. Equations of disturbed motion are analyzed by systematically described methods for the determination of natural frequencies and vibration modes. Also equations for the aerodynamic forces acting upon the vibrating wing are examined, along with those acting upon the vehicle when the fuel in the storage tanks is in shaking motion. The dynamic properties of flight vehicles are represented by transfer functions and amplitude and phase characteristics of frequency. Using frequency and root locus methods, a stability analysis of the flight vehicle-stabilization system closed loop is performed. M.V.E.

A75-12332 # Optimization of automated static tests of gas turbine engines (Optimizatsiia avtomatizirovannykh stendovykh ispytaniy GTD). Iu. V. Kozhevnikov, M. Kh. Bikhantayev, V. D. Shershukov, and R. I. Adgarmov. Moscow, Izdatel'stvo Mashinostroenie, 1974. 104 p. 21 refs. In Russian.

The performance evaluation and optimization procedures applied to gas turbine engines undergoing automated static tests are reviewed. A demonstration is presented for the derivation of analytical expressions describing gas turbine engine characteristics from experimental data reduced to standard atmosphere conditions by the regression analysis method. Confidence limit determination procedures are set forth for the evaluation of performance variation findings. A mathematical model of gas turbine engine control by an automated control system is described, and control algorithms based on linear and quadratic programming are given. M.V.E.

A75-12345 The problem of three-dimensional lifting potential flow and its solution by means of surface singularity distribution. J. L. Hess (Douglas Aircraft Co., Long Beach, Calif.). *Computer Methods in Applied Mechanics and Engineering*, vol. 4, Nov. 1974, p. 283-319. 14 refs. Navy-sponsored research.

This paper describes a method for calculating potential flow about arbitrary three-dimensional lifting bodies without the approximations inherent in small-perturbation or lifting-surface theories. The mathematical description of the lifting problem is merely a model to describe by means of an inviscid flow a phenomenon that is ultimately due to viscosity. This is true even in two dimensions, but in three dimensions it leads to certain logical difficulties. The present method differs from other current methods mainly in its use of finite-strength surface vorticity distributions instead of concentrated line vorticity interior to the body and in its application of the Kutta condition. Comparisons indicate advantages for the formulation of the present method. A selection of cases calculated by the present method is presented to illustrate its versatility and usefulness. Comparisons of the calculations with experimental data are presented. The importance of viscosity in the experimental results is illustrated. (Author)

A75-12372 # Safety and air navigation. A. Stratton. *Journal of Navigation*, vol. 27, Oct. 1974, p. 407-443; Discussion, p. 444-449. 24 refs.

To identify the navigation contribution to air accidents with certainty requires a detailed examination of the events in 'collision' types of accidents; this is only practical on a sample basis. Examination of statistical trends over long periods has necessarily been confined to listed mid-air collisions and collisions with high ground, in both of which a high probability of 'navigation' content may be presumed. When comparison is required with the growth of air traffic this is confined to the readily available data on ICAO-scheduled passenger flights (1950-1973). F.R.L.

A75-12373 # Navigation in the use of helicopters offshore. R. J. Van der Harten and A. Oprel (KLM Noordzee Helikopters, Schiphol Airport, Netherlands). *Journal of Navigation*, vol. 27, Oct. 1974, p. 450-460; Discussion, p. 461-463. 8 refs.

This paper describes the operation of a 24-hour service now available for supplying pilots to ships entering the harbour of Rotterdam and for maintaining communications with North Sea oil rigs, with special reference to the unusual navigational problems involved. (Author)

A75-12420 # Short SD3-30. *Aircraft Engineering*, vol. 46, Oct. 1974, p. 4-6, 8-15, 18-30.

The Short SD3-30 is the first commuter airliner with wide-body design and walk-about headroom for passengers. It is a twin-turboprop aircraft designed for up to 30 passengers plus 3 crew or 7500 lb of freight, with optimum operating economics range of rotor blades. Filament winding as a rotor fabrication process is discussed as a cost effective method offering good potential for automated production. Results of testing are summarized on matching blade stiffness criteria and improving rotor blade survivability. (Author)

A75-12473 # Some problems of the canard configuration. I (Niektóre problemy układu kaczkii. I). J. Staszek. *Technika Lotnicza i Astronautyczna*, vol. 29, Sept. 1974, p. 10-16. 13 refs. In Polish.

Some phenomena associated with the dynamic stability of a canard configuration at low subsonic speeds are discussed. The influence of flow separation at the canard on the wing is analyzed, and the difficulties involved in calculating the flow separation angles at the wing are pointed out. The nature of the displacement of the center of buoyancy in a canard configuration is illustrated. V.P.

A75-12474 # Kasprzyk's revelatory wing (Rewelacyjne skrzydło W. Kasprzyka). T. Wusatowski. *Technika Lotnicza i Astronautyczna*, vol. 29, Sept. 1974, p. 17, 18, 40. In Polish.

Some phenomena experienced by Kasprzyk when flying his BKB-1 glider with a superlift wing are discussed and explained. The concept of a superlift wing is examined, and the advantages which accrue from its application are outlined. V.P.

A75-12475 # Selected problems concerning the strength of a bonded heavily loaded Dural structure (Wybrane zagadnienia wytrzymałościowe klejonej, wysokoobciążonej konstrukcji duralowej). K. Szuster. *Technika Lotnicza i Astronautyczna*, vol. 29, Sept. 1974, p. 29-34. In Polish.

The advantages of adhesive bonding are demonstrated by examples of the application of the technique in aircraft industry. Particular attention is given to results obtained in the preparation of laminated coatings and wing spars for a perspective glider. V.P.

A75-12525 MBB BO 105. II - Concept and worldwide use (MBB BO 105. II - Konzept und weltweiter Einsatz). E. Rumpler and H. Frommlet. *Flug Revue/Flugwelt International*, Nov. 1974, p. 31-34, 39, 40. In German.

The principles of operation of the control system of the aircraft are considered, giving attention also to a number of new design features in the hydraulic system. Basic requirements concerning the design of the airframe cell are discussed along with the advantages obtained by a high position of the rotor in the rear, flight tests, the equipment of the BO 105, aspects of helicopter employment in police and rescue service, the use of the aircraft in military applications, and questions regarding the further development of the helicopter. A brief analysis regarding the factors which limit the speed of the helicopter is conducted as a basis for design improvements to increase the helicopter speed as much as feasible. G.R.

A75-12571 # Installation benefits of the single-engine exhaust nozzle on the YF-16. W. C. Bittrick (General Dynamics Corp., Fort Worth, Tex.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 10th, San Diego, Calif., Oct. 21-23, 1974, AIAA Paper 74-1101*. 12 p.

Nozzle integration features on the YF-16 and the simplified tests employed to evaluate the installation and to predict installed performance are described. Jet-effects model test results are presented for nozzle configurations representing the aerodynamic force model plus both cruise- and combat-power geometries. Results of a later, more-sophisticated jet-effects test are shown to verify the conclusion that single-engine installed performance can be closely approximated by isolated performance estimates. (Author)

A75-12618 # Stability limits for downsprings. G. Sachs (Darmstadt, Technische Hochschule, Darmstadt, West Germany). *Journal of Aircraft*, vol. 11, Nov. 1974, p. 710-712. 6 refs.

Analysis of the effect of downsprings on the stability characteristics of light aircraft. An attempt is made to determine the most restrictive conditions with regard to downsprings by means of an analysis based on a stability quartic similar to the control-fixed case, with the boundaries of the stability region determined by the constant term of the characteristic equation and by Routh's discriminant. A.B.K.

A75-12619 # Potential flow past annular aerofoils. V. Krishnamurthy and N. R. Subramanian (Indian Institute of Technology, Madras, India). *Journal of Aircraft*, vol. 11, Nov. 1974, p. 712-714. 6 refs.

Three different methods are used in the study of the potential flow. A nonlinear approach reported by Young (1972) makes use of a combination of source and vortex distributions. Another method employs a rheoelectric analogy. The third method is based on a consideration of source distributions on the body. The investigation shows that the rheoelectric analogy provides a good first approximation in the solution of problems involving flow past annular aerofoils with and without central bodies. G.R.

A75-12620 * # Roll-up of aircraft trailing vortices using artificial viscosity. A. M. Bloom (NASA, Langley Research Center, Joint Institute for Acoustics and Flight Sciences, Hampton, Va.; George Washington University, Washington, D.C.) and H. Jen (NASA, Langley Research Center, Joint Institute for Acoustics and Flight Sciences, Hampton, Va.). *Journal of Aircraft*, vol. 11, Nov. 1974, p. 714-716. 10 refs.

The artificial viscosity method of Kuwahara and Takami (1973) is used to calculate the roll-up of trailing vortices behind a number of practical aerodynamic configurations. Where possible, the results are compared for core location with available experimental data. M.V.E.

A75-12621 * # Correlation for estimating vortex rotational velocity downstream dependence. D. L. Ciffone (NASA, Ames Research Center, Moffett Field, Calif.). *Journal of Aircraft*, vol. 11, Nov. 1974, p. 716, 717.

Description of a correlation, derived from water tank measurements in the wake of wings towed under water, that makes it possible to predict the downstream distance behind an aircraft in flight where its trailing vortex will begin to decay. Comparisons of measured and predicted data are discussed. M.V.E.

A75-12622 * # Static aeroelasticity and the flying wing, revisited. T. A. Weisshaar (Virginia Polytechnic Institute and State University, Blacksburg, Va.) and H. Ashley (Stanford University, Stanford, Calif.). *Journal of Aircraft*, vol. 11, Nov. 1974, p. 718-720. 5 refs. Grants No. AF-AFOSR-74-2712; No. NSG-2016.

The roll dynamic behavior of some wing configurations is examined. Analysis shows that the static divergence instability which occurs for symmetrical or clamped sweptforward wings is modified by roll freedom. The instability found in the present highly idealized analysis is still of an aperiodic nature, but at a speed above the conventional divergence speed. The magnitude of this difference is seen to be a function of the ratio of the wing roll mass moment of inertia to the mass moment of inertia of the wing about the roll axis, and this difference may be quite significant. P.T.H.

A75-12638 Generation of aerodynamic profiles and establishing the circulation around a wing by deformation of the wing (Sur la génération des profils aérodynamiques et l'installation de la circulation autour d'une aile par déformation de cette dernière). R. Laporte. *Académie des Sciences (Paris), Comptes Rendus, Série A - Sciences Mathématiques*, vol. 279, no. 8, Aug. 19, 1974, p. 293-296. In French.

A classical result concerning the conformal transformation of unbounded, simply connected areas is obtained. It is then shown that there is the possibility to establish the circulation around a wing by periodically deforming the profile of the wing. M.V.E.

A75-12720 Shuttle orbiter flight test plan evolves. D. E. Fink. *Aviation Week and Space Technology*, vol. 101, Nov. 11, 1974, p. 45-47, 49.

NASA's No. 1 space shuttle orbiter will be flown through two series of captive flights on its Boeing 747 piggyback carrier aircraft before it is separated on the first free-fall approach and landing test. The carrier aircraft will have the best altitude and range performance on ferry flights with the orbiter set at a 5-deg positive angle of attack. An angle of 8 deg is thought to be best for the approach and landing separation maneuver. It is considered that a positive separation can be achieved without using flaps, spoilers, and lowered landing gear. F.R.L.

A75-12722 Teledyne aims at low-cost engines. M. L. Yaffee. *Aviation Week and Space Technology*, vol. 101, Nov. 11, 1974, p. 55, 57, 58.

The Teledyne CAE/Navy J402-CA-400 turbojet, selected as the cruise engine for the McDonnell Douglas Harpoon anti-ship missile, has been designed for high reliability at low cost. It is an expendable engine that uses low-cost castings generally in the as-cast condition.

Materials and manufacturing methods were dictated by the need for low cost and five-year storage life in a marine environment. Regardless of launching mode, the Harpoon is designed to fly at sea level at a cruise speed of Mach 0.85. The missile is boosted to cruise speed by a solid propellant rocket motor in the case of a surface or subsurface launch. The J402 turbojet is programmed to start after the missile is boosted to cruise speed. F.R.L.

A75-12725 * A study on aircraft map display location and orientation. D. L. Baty, T. E. Wempe, and E. M. Huff (NASA, Ames Research Center, Man-Machine Integration Branch, Moffett Field, Calif.). *IEEE Transactions on Systems, Man, and Cybernetics*, vol. SMC-4, Nov. 1974, p. 560-568.

Six airline pilots participated in a fixed-base simulator study to determine the effects of two horizontal situation display (HSD/map) panel locations relative to the vertical situation display (VSD), and of three map orientations on manual piloting performance. Pilot comments and opinions were formally obtained. Significant performance differences were found between wind conditions and among pilots, but not between map locations and orientations. The results also illustrate the potential tracking accuracy of such a display. Recommendations concerning display location and map orientation are made. (Author)

A75-12726 Failure analyses of aircraft accidents. II. J. B. Shah (Ministry of Transport, Engineering Laboratory, Ottawa, Canada). *Metals Engineering Quarterly*, vol. 14, Nov. 1974, p. 23-29.

Failures in aircraft components caused by decarburization, corrosion, abnormal misalignment, and overloading are discussed. Precautionary methods used to reduce these failures are included. To illustrate the effects of fretting and corrosion failure two designs, one attributed to insufficient design and the other to inadequate maintenance, are considered. Certain stress-bearing components are covered such as connecting rods, spar tubes, spring legs, eyebolts, and drive shafts. T.S.

A75-12729 Evaluating new aluminum forging alloys. J. T. Staley (Alcoa Technical Center, Alcoa Center, Pa.). *Metals Engineering Quarterly*, vol. 14, Nov. 1974, p. 50-55. 16 refs. Contract No. F33615-69-C-1644.

Die forgings in alloys 7050, 7049, special process 7175, and MA52 (variant of Boeing 21 and Reynolds RX720) were fabricated and evaluated for resistance to stress-corrosion cracking, quench sensitivity, and fracture toughness. Analyses of results of almost 1,000 tensile tests, 2,000 stress-corrosion tests, and 200 fracture toughness tests indicate that all of the alloys were less quench sensitive than alloy 7075, and when overaged to T7 tempers, all developed better combinations of strength and resistance to stress-corrosion cracking and fracture toughness than 7075-T6 and 7079-T6 of equal strengths. Because 7050 developed the best combination of properties, it is a preferred selection for use as die forgings of relatively heavy section thickness for the aerospace industry. Special process 7175 is an equally good selection for die forgings of thin to moderate section thickness. (Author)

A75-12825 Fly-by-wire is here. *Exxon Air World*, vol. 26, no. 4, 1974, p. 95-99.

Fly-by-wire (FBW) is a form of flight control, by which the pilot is linked to the control surfaces through electrical, rather than mechanical, linkages. Flight tests have shown that FBW improves flight smoothness and aircraft control in turbulence. FBW is combined with the principle of controlled configured vehicle (CCV) in the American YF-16, the first airplane designed from the outset for FBW control. These features make possible a smaller, lighter, more economical fighter. An airborne computer is used to produce the most effective control movements to achieve piloting intentions. The pilot's control is through a side-stick controller. FBW control is being designed for helicopters in the USA and for other aircraft, such as the Concorde, in Europe. A.T.S.

A75-12829 # Measurement of pitching moment on an oscillating rectangular wing at transonic speeds using the resonance method. H. Kimura. *Kyushu University, Technology Reports*, vol. 47, Mar. 1974, p. 137-142. In Japanese.

A75-12931 # Automated computerized ultrasonic rating system provides new level of design confidence. J. A. Harlan, J. J. Connelly, C. J. Carter, and R. A. Cellitti (International Harvester Co., Hinsdale, Ill.). In: Automated inspection and product control; Proceedings of the Conference, Chicago, Ill., October 15-17, 1974. Chicago, IIT Research Institute, 1974, p. 165-202. 8 refs.

A75-12933 # A computer automated ultrasonic inspection system for aircraft forgings. B. G. W. Yee (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.) and J. E. Allison (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). In: Automated inspection and product control; Proceedings of the Conference, Chicago, Ill., October 15-17, 1974. Chicago, IIT Research Institute, 1974, p. 265-275. 6 refs. Contract No. F33615-72-C-1828.

This paper describes a computer-automated ultrasonic immersion inspection system which will be used to inspect aircraft forgings. The system is capable of automatically inspecting objects with nonplanar surfaces, such as tapers, fillets and large radii. Modes of operation include both pulse echo and Delta scan inspection, with computer control of scanning, data acquisition, processing and display. Flaw signals are input in the rf form to allow defect characterization. The system uses a PDP 11/45 mini-computer with a magnetic disk and Tektronix Graphics Terminal serving as the prime peripherals. The system described in this paper has the potential to decrease ultrasonic inspection costs and increase inspection reliability, the later being necessary for the implementation of the fracture mechanics design philosophy. (Author)

A75-13000 # The use of jet fuels in aviation (Primenenie reaktivnykh topliv v aviatsii). Ia. B. Chertkov and V. G. Spirkin. Moscow, Izdatel'stvo Transport, 1974. 161 p. 245 refs. In Russian.

The present work describes the sources and methods for obtaining fuels for jet aircraft, their composition, physical and chemical properties, and performance characteristics. Means for further perfection of jet fuels are outlined with emphasis on the unification of the various kinds with the goal of employing only one type of fuel for aircraft attaining a velocity of Mach 2.5. The properties of non-Soviet fuels are set forth, and their possible interchangeability with Soviet types is discussed. The possibility of improving the qualities of fuels by means of the introduction of additives or by deoxidation (nitrogen saturation) is pointed out. The characteristics, effectiveness, and application of various additives are described. P.T.H.

A75-13023 Acoustics of the sonic boom. V. G. Ward. Worthington, Ohio, V. G. Ward, 1974. 34 p. 23 refs. \$3.00.

An investigation was conducted regarding the characteristics of the sonic boom produced by an F-104 aircraft flying a near overhead course at 40,000 feet altitude at a Mach number of 2.0. The investigation shows that a sound recording, outdoors, of a sonic boom is feasible when the recorder and the microphone are adequately covered by cotton batting. The cotton batting effectively reduces the high pressure rise of the aircraft shock waves so that sound-level amplitudes of the boom may be magnetically recorded. G.R.

A75-13026 # Applied aerodynamics (Prikladnaia aerodinamika). N. F. Krasnov, V. N. Koshevoi, A. N. Danilov, V. F. Zakharchenko, E. E. Borovskii, and A. I. Khlupnov. Moscow, Izdatel'stvo Vysshiaia Shkola, 1974. 732 p. 52 refs. In Russian.

The fundamentals of applied aerodynamics are outlined, using an approach based on the use of wind-tunnel and other experimental data, modern experimental methods, and programmed data processing techniques. Much attention is given to experimental aerodynamics, including methods of calculating and designing subsonic and supersonic aerodynamic facilities, measuring systems, and methods of determining aerodynamic characteristics. The formulation and solution of problems of fluid dynamics, kinematics, and shock wave theory are studied, and the problems are used to demonstrate the various methods for calculating the parameters of flows past wings, bodies of revolution, and supersonic aircraft. Pressure, friction, and heat-transfer problems are treated in some detail. V.P.

A75-13028 Materials on the move; Proceedings of the Sixth National Technical Conference, Dayton, Ohio, October 8-10, 1974. Conference sponsored by the Society for the Advancement of Material and Process Engineering. Azusa, Calif., Society for the Advancement of Material and Process Engineering (National SAMPE Technical Conference Series. Volume 6), 1974. 474 p. \$40.

Recent developments in materials and processing methods for aircraft and ground transportation applications are described in a series of papers. Some of the topics covered include: new urban systems/design criteria and concepts, the application of damping in transportation vehicles, holographic nondestructive testing, acoustic emission for aircraft structures, directionally solidified eutectics for use in advanced gas turbine engines, oxide dispersion strengthened alloys for aircraft turbine engine vanes, close tolerance special materials for aerospace components, boron/aluminum for space applications, and graphite/thermoplastic bearings.

P.T.H.

A75-13029 * Design objectives - Air transportation. M. A. Beheim (NASA, Lewis Research Center, Wind Tunnel and Flight Div., Cleveland, Ohio). In: Materials on the move; Proceedings of the Sixth National Technical Conference, Dayton, Ohio, October 8-10, 1974. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1974, p. 1-4.

The mainline of air transportation is expected to continue to be based on the medium to long haul turbine powered subsonic aircraft. With greater emphasis on energy conservation, there will be considerable interest in making additional progress in propulsion system efficiency. Continued improvement in turbofan engines is expected to occur, but there may be a less conventional approach in the background. Opportunities for expanding short haul air services will certainly materialize. The outlook for supersonic air transport is less clear because of complex political and economic factors. F.R.L.

A75-13035 From creaking cracks to breaking beams - A review of acoustic emission for aircraft structure. C. D. Bailey and W. H. Lewis (Lockheed-Georgia Co., Marietta, Ga.). In: Materials on the move; Proceedings of the Sixth National Technical Conference, Dayton, Ohio, October 8-10, 1974. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1974, p. 118-128.

This paper describes three separate areas of activity currently being pursued in acoustic emission testing technology. An acoustic emission system known as the Flight Structural Monitoring System was developed and used to detect major cracking in full size aircraft structural components during dynamic loading. The system is currently being flight tested on a C-5 Galaxy. A flaw locator was used to detect small crack extensions in structural specimens during fatigue testing. High precision measurements of structural-borne noise are currently being made on aircraft structure during flight to determine the feasibility of an onboard acoustic emission system to detect crack initiation and monitor crack growth. (Author)

A75-13039 Development of high strength cast superalloys with hot corrosion resistance. R. P. Dalal and L. J. Fiedler (Avco Corp., Avco Lycoming Div., Stratford, Conn.). In: *Materials on the move; Proceedings of the Sixth National Technical Conference*, Dayton, Ohio, October 8-10, 1974. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1974, p. 196-207. 12 refs.

A development program was conducted to improve the stress rupture strength of an inherently sulfidation resistant nickel-base superalloy. The goal was to obtain the equivalent of a 25 F improvement in temperature capability while retaining the desirable environmental (hot corrosion) characteristics of the basic alloy system. An initial series of laboratory heats was melted and evaluated using stress rupture strength, hot corrosion-resistance and microstructural stability as screening criteria. Additional laboratory heats were formulated with the aid of computerized phase stability techniques and melted to define a narrower compositional range. A composition was established which met the program goals, i.e., an increased strength capability of 20 F to 30 F over the applicable temperature range with only a nominal change in sulfidation resistance. (Author)

A75-13040 Oxide dispersion strengthened alloys for aircraft turbine engine vanes. P. G. Bailey (GE Material and Process Technology Laboratories, Cincinnati, Ohio). In: *Materials on the move; Proceedings of the Sixth National Technical Conference*, Dayton, Ohio, October 8-10, 1974. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1974, p. 208-217.

Oxide dispersion strengthened (ODS) alloys are attractive for aircraft turbine engine vanes because of high temperature strength, overtemperature protection and thermal fatigue resistance. Applications have been limited because of high costs and sparse design experience. Recent advances include a directional recrystallization process and preliminary development of NiCrAl ODS alloys. (Author)

A75-13041 Polycarbonate aircraft transparencies. W. A. Miller (Sierracin Corp., Sylmar, Calif.). In: *Materials on the move; Proceedings of the Sixth National Technical Conference*, Dayton, Ohio, October 8-10, 1974. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1974, p. 218-228. 6 refs.

For many years, engineers have selected glass or acrylic materials for aircraft transparencies. However, during the last decade there has emerged another transparent engineering plastic; namely, polycarbonate, that has surpassed the performance of both glass and acrylic for certain applications. This paper deals with the background and some of the important features of polycarbonate relevant to aircraft transparency design and fabrication. Current aircraft usage is described, and a prediction is made concerning the future of polycarbonate in this industry. Some of the test methods currently employed to verify adequacy of design or manufacture are also discussed. (Author)

A75-13043 Improved primer coating systems for the transportation industries. C. C. Fong (Lockheed-California Co., Burbank, Calif.). In: *Materials on the move; Proceedings of the Sixth National Technical Conference*, Dayton, Ohio, October 8-10, 1974. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1974, p. 239-243.

To eliminate recognized deficiencies in traditional epoxy primers and to gain the desirable attributes of polyurethane coatings, a new type of polyurethane primer was developed. This new primer retains the high adhesion, chemical resistance, and corrosion resistance of epoxies while maintaining the desirable flexibility, impact, strippability, and recoatability characteristic of urethanes. This

coating has been evaluated in numerous laboratory investigations and will now be tested on selected aircraft, railroad cars, buses, and other vehicles to determine its performance under typical service conditions. (Author)

A75-13044 Weldability and quality of titanium alloy weldments. R. Witt, A. Flescher, and O. Paul (Grumman Aerospace Corp., Bethpage, N.Y.). In: *Materials on the move; Proceedings of the Sixth National Technical Conference*, Dayton, Ohio, October 8-10, 1974. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1974, p. 250-270. Contracts No. F33615-72-C-2039; No. F33615-72-C-1624. AF Project 7381.

This paper is concerned with the production of high-integrity welded structures of alpha-beta and the newer beta titanium alloys using advanced welding techniques such as electron-beam, plasma-arc and gas-tungsten-arc welding. Future mission requirements and the introduction of new alloys, welding processes and improved non-destructive inspection techniques will increase the utilization of titanium alloy weldments in primary airframe structures. (Author)

A75-13045 Structural advances in helicopter rotor blade technology. L. J. Ashton and I. E. Figge, Sr. In: *Materials on the move; Proceedings of the Sixth National Technical Conference*, Dayton, Ohio, October 8-10, 1974. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1974, p. 314-323.

Four related research efforts to develop tubular spar concepts for helicopter rotor blades have been successfully completed using the wet impregnation filament winding technique. Combinations of fiberglass, Kevlar 49, and graphite fibers in epoxy matrix were used to substantiate the objective of designing dynamic tailorability into rotor blades. Filament winding as a rotor fabrication process is discussed as a cost effective method offering good potential for automated production. Results of testing are summarized on matching blade stiffness criteria and improving rotor blade survivability. (Author)

A75-13046 Laminated metallic structure - Advanced applications. S. W. McClaren and J. R. Ellis (LTV Aerospace Corp., Vought Systems Div., Dallas, Tex.). In: *Materials on the move; Proceedings of the Sixth National Technical Conference*, Dayton, Ohio, October 8-10, 1974. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1974, p. 345-351. 6 refs.

This paper presents the summary observations of several investigators related to the benefits obtainable from lamination methods. Further discussion deals with two major laminated component evaluation efforts. Future development requirements and applications of laminated metallics are discussed and specific conclusional statements are made. (Author)

A75-13047 Applications of graphite and aramid composites on the YF-17 prototype fighter. H. F. Click, Jr. (Northrop Corp., Hawthorne, Calif.). In: *Materials on the move; Proceedings of the Sixth National Technical Conference*, Dayton, Ohio, October 8-10, 1974. Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1974, p. 352-360. Contract No. F33657-72-C-0706.

Two advanced composite materials, graphite/epoxy and aramid/epoxy, were selected to achieve YF-17 weight savings without sacrificing strength or performance. Material test requirements, procurement and process specifications, and assembly fabrication are described. Initial design weight savings of 360 pounds and the successful first flights of the aircraft demonstrate feasibility for use of these materials as structural components on the YF-17 and similar aircraft. (Author)

A75-13048 * **Boron/aluminum for space applications.** A. R. Robertson and M. F. Miller (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). In: *Materials on the move; Proceedings of the Sixth National Technical Conference*, Dayton, Ohio, October 8-10, 1974. , Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1974, p. 361-368. 6 refs. Contracts No. NAS8-27738; No. F33615-74-C-5151; No. F33615-72-C-1460.

Several experimental boron/aluminum structures have been built for aircraft and space vehicle applications. The success of these structures has led to the decision to use boron/aluminum tubular struts on the mid-fuselage section of the Space Shuttle Orbiter. The suitability of boron/aluminum for this application has been demonstrated in a program that involved fabricating 100 tubes and performing static, fatigue, corrosion, thermal/mechanical fatigue, and damage tolerance tests on them. Other potential applications for boron/aluminum on the Space Shuttle include the wing carry-through panels and side panels for the mid-fuselage, and the landing gear struts. These applications result in significant weight savings over conventional non-composite designs at moderate costs. Boron/aluminum can now be considered a production material that, in many cases, is competitive on a weight and/or cost basis with an all-metal or resin composite system. (Author)

A75-13132 # **Low-frequency three-dimensional profile vibrations in transonic gas flow (Niz'kochastotni kolivannia tilesnogo profilu v navkolozvukovomu pototsi gazu).** G. F. Sigalov (Irkutsk'kii Derzhavnii Universitet, Irkutsk, USSR). *Akademiia Nauk Ukrain's'koi RSR, Dopovidi, Seriya A - Fiziko-Tekhnichni i Matematichni Nauki*, vol. 36, Sept. 1974, p. 825-829. 6 refs. In Ukrainian.

Investigation of the boundary value problem for a gasdynamic differential equation describing the low-frequency vibrations of a three-dimensional profile in transonic gas flow. The study is based on an asymptotic method leading to complete approximation. Already in the first approximation for the obtained problem solution, nonlinear effects are allowed for. M.V.E.

A75-13149 **S-3A Viking - Carrier's shield.** M. Lambert. *Flight International*, vol. 106, Nov. 7, 1974, p. 641-646.

The S-3A is primarily an anti-submarine aircraft and is therefore equipped to carry in its two-chamber, four-rack internal weapon bay the expected choice of Mk 46 torpedoes, depth bombs, destructors, and 'special', presumably nuclear, weapons. All aircraft are being delivered with their under-wing pylons fitted and on these they can carry external fuel tanks or an assortment of bombs, cluster bombs, and rocket launchers. Because so much of the analytical and calculating work in the S-3A is done by on-line computing and displayed electronically in diagrammatic and written form, it has been possible to reduce this exceptional work density to a complex of tasks which can be handled by only four men. F.R.L.

A75-13052 **MIL-H-83282 fire resistant hydraulic fluid.** C. E. Snyder and H. Schwenker (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). In: *Materials on the move; Proceedings of the Sixth National Technical Conference*, Dayton, Ohio, October 8-10, 1974. , Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1974, p. 428-438.

The fluid properties of the new MIL-H-83282 material are described and compared with the properties of MIL-H-5606 in terms of hydraulic system performance including all the ground and flight tests accumulated with MIL-H-83282 to date. MIL-H-83282 hydraulic fluid either meets or exceeds the requirements of MIL-H-5606(B) with one exception, i.e., low temperature viscosity. MIL-H-83282 hydraulic fluid within its temperature envelope (-50 deg F to 400 deg F) is a superior hydraulic fluid to MIL-H-5606 in many other property/performance characteristics besides fire resistance.

F.R.L.

A75-13069 # **Rationale for cost-weight analysis.** M. E. Talley and R. N. Mueller (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-961*. 6 p. 7 refs. Members, \$1.50; nonmembers, \$2.00.

The need and rationale for the implementation of an airframe structural cost-weight estimating system suitable for preliminary design trade studies is described. The system is intended to be sufficiently detailed to account for different combinations of design concepts, material applications, and manufacturing processes. Full implementation of the system for design-to-cost programs will require development of (1) a common format for cost and weight data, (2) manufacturing analysis suitable to preliminary design, and (3) assessment of damage tolerance criteria on cost and weight.

(Author)

STAR ENTRIES

N75-10003# Advisory Group for Aerospace Research and Development, Paris (France).

HINGELESS ROTORCRAFT FLIGHT DYNAMICS

Kurt H. Hohenemser (Washington Univ., St. Louis) and Robert A. Ormiston, ed. (Army Air Mobility R and D Lab., Moffett Field, Calif.) Sep. 1974 50 p refs

(AGARD-AG-197; AGARDograph-197) Avail: NTIS HC \$3.75

The state of hingeless rotorcraft research and development in the NATO countries as of 1973 is described. The scope of this report is limited to flight dynamics since most of the hingeless rotorcraft problems have occurred in this area. The special place of the hingeless rotorcraft within the family of rotorcraft is considered. The chapter on the history of hingeless rotorcraft describes the hingeless rotor research and development of the various rotorcraft manufacturers and the hingeless rotor research at government laboratories and universities. A hierarchy of dynamic concepts from isolated blade dynamics to complete rotor/body dynamics is introduced. The effects of the basic rotor design parameters on flight dynamics are traced and certain hingeless rotorcraft problems are treated in some detail. A special chapter is devoted to the alleviation of hingeless rotor flight-dynamics problems by feedback control systems. Analytical modeling techniques, mathematical analysis techniques, and model and flight testing techniques for hingeless rotorcraft are discussed.

Author

N75-10004*# National Aeronautics and Space Administration: Ames Research Center, Moffett Field, Calif.

SOME FACTORS AFFECTING THE USE OF LIGHTER THAN AIR SYSTEMS

C. Dewey Havill Sep. 1974 43 p refs

(NASA-TM-X-62374) Avail: NTIS HC \$3.75 CSCL 01C

The uses of lighter-than-air vehicles are examined in the present day transportation environment. Conventional dirigibles were found to indicate an undesirable economic risk due to their low speeds and to uncertainties concerning their operational use. Semi-buoyant hybrid vehicles are suggested as an alternative which does not have many of the inferior characteristics of conventional dirigibles. Economic and performance estimates for hybrid vehicles indicate that they are competitive with other transportation systems in many applications, and unique in their ability to perform some highly desirable emergency missions.

Author

N75-10005*# Lockheed-Georgia Co., Marietta.

GROUND EFFECT FOR V/STOL AIRCRAFT CONFIGURATIONS AND ITS SIMULATION IN THE WIND TUNNEL. PART 3: THE TANGENTIALLY BLOWN GROUND AS AN ALTERNATIVE TO A MOVING GROUND: APPLICATION TO THE NASA-AMES 40 BY 80-FOOT WIND TUNNEL

J. E. Hackett, E. B. Praytor, and E. O. Caldwell [1973] 59 p refs

(Contract NAS2-6690)

(NASA-CR-114497) Avail: NTIS HC \$4.25 CSCL 01B

A set of conceptual drawings showing the application of slot-blowing boundary layer control to the 40- by 80-foot wind tunnel is presented. In small scale pilot experiments unswept slots were used, fed by a below-floor plenum. The model was sting mounted and its wing was unswept. However, design for the Ames tunnel was heavily constrained, both by under floor balance mechanisms and by a large turntable. An over floor supply system was therefore designed. A description of appropriate

procedures for using the floor tangential blowing system is given. Though some of the operating graphs are specific to the design for the Ames tunnel, both non-dimensional plots and the approach generally are widely applicable.

Author

N75-10006*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXTRACTION FROM FLIGHT DATA OF LATERAL AERODYNAMIC COEFFICIENTS FOR F-8 AIRCRAFT WITH SUPERCRITICAL WING

James L. Williams and William T. Suit Washington Nov. 1974 37 p refs

(NASA-TN-D-7749; L-9619) Avail: NTIS HC \$3.75 CSCL 01C

A parameter-extraction algorithm was used to determine the lateral aerodynamic derivatives from flight data for the F-8 aircraft with supercritical wing. The flight data used were the recorded responses to aileron or rudder pulses for Mach numbers of 0.80, 0.90, and 0.98. Results of this study showed that a set of derivatives were determined which yielded a calculated aircraft response almost identical with the response measured in flight. Derivatives extracted from motion resulting from rudder inputs were somewhat different from those resulting from aileron inputs. It was found that the derivatives obtained from the rudder-input data were highly correlated in some instances. Those from the aileron input had very low correlations and appeared to be the more reliable.

Author

N75-10007*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND TUNNEL TESTS OF MODIFIED CROSS, HEMISFLO, AND DISK-GAP-BAND PARACHUTES WITH EMPHASIS IN THE TRANSONIC RANGE

Jerome T. Foughner, Jr. (Goodyear Aerospace Corp.) and William C. Alexander Washington Nov. 1974 38 p refs

(NASA-TN-D-7759; L-9421) Avail: NTIS HC \$3.75 CSCL 01C

Transonic wind-tunnel studies were conducted with modified cross, hemisflo, and disk-gap-band parachute models in the wake of a cone-cylinder shape forebody. The basic cross design was modified with the addition of a circumferential constraining band at the lower edge of the canopy panels. The tests covered a Mach number range of 0.3 to 1.2 and a dynamic pressure range from 479 Newtons per square meter to 5746 Newtons per square meter. The parachute models were flexible textile-type structures and were tethered to a rigid forebody with a single flexible riser. Different size models of the modified cross and disk-gap-band canopies were tested to evaluate scale effects. Model reference diameters were 0.30, 0.61, and 1.07 meters (1.0, 2.0, and 3.5 ft) for the modified cross; and nominal diameters of 0.25 and 0.52 meter (0.83 and 1.7 ft) for the disk-gap-band; and 0.55 meter (1.8 ft) for the hemisflo. Reefing information is presented for the 0.61-meter-diameter cross and the 0.52-meter-diameter disk-gap-band. Results are presented in the form of the variation of steady-state average drag coefficient with Mach number. General stability characteristics of each parachute are discussed. Included are comments on canopy coning, spinning, and fluttering motions.

Author

N75-10008*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A PARAMETRIC STUDY OF EFFECT OF FOREBODY SHAPE ON FLOW ANGULARITY AT MACH 8

Charles B. Johnson and Don C. Marcum, Jr. Washington 20 Nov. 1974 48 p refs

(NASA-TN-D-7768; L-9639) Avail: NTIS HC \$3.75 CSCL 20D

Flow angularity and static pressure measurements have been made on the lower surface of nine forebody models that simulate the bottom forward surface of a hypersonic aircraft. Measurements were made in an area of the forebody that represents the location of an inlet of a scramjet engine. A parametric variation of the forebody surface investigated the effect of: (1) spanwise curvature; (2) longitudinal curvature; and (3) planform shape on both flow

angularity and static pressure distribution. Results of each of the three parametric variations of geometry were compared to those for the same flat delta forebody. Spanwise curvature results showed that a concave shape and the flat delta had the lowest flow angularity and lowest rate of increase in flow angularity with angle of attack. Longitudinal curvature results showed a convex surface to give the better flow at the higher angles of attack. The better of the two planform shapes tested was a convex elliptical shape. Limited flow field calculations were made at angles of attack using a three dimensional, method-of-characteristics program. In general, at all angles of attack there was agreement between data and theory. Author

N75-10009* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

AN EXPLORATORY FLIGHT INVESTIGATION OF HELICOPTER SLING-LOAD PLACEMENTS USING A CLOSED-CIRCUIT TELEVISION AS A PILOT AID

Daniel J. DiCarlo, Henry L. Kelley (US Army Air Mobility R and D Lab.), and Kenneth R. Yenni Washington 20 Nov. 1974 23 p refs (NASA-TN-D-7776; L-9744) Avail: NTIS HC \$3.25 CSCL 01B

Helicopter sling load operations have been limited during pick up and delivery of external cargo by the lack of precision achieved by the combination of pilot, helicopter, and sling load. Use of a closed circuit television as a pilot aid during sling load delivery and placement was documented along with additional cases representing procedures currently employed by military and commercial operators. Although an increase in pilot workload was noted when the television system was used, the results indicated a comparable level of performance for each test case. Author

N75-10010 Saab-Scania, Linkoping (Sweden).

APPLICATION OF THE POLAR COORDINATE METHOD TO OSCILLATING WING CONFIGURATIONS

Valter J. E. Stark [1974] 42 p refs (SAAB-TN-69) Avail: NTIS HC \$3.75

A previously published method for the calculation of aerodynamic forces on oscillating wings with partial-span control-surfaces in subsonic flow by using polar integration variables has been generalized and programmed in FORTRAN. The program can treat combinations of up to 10 trapezoidal surfaces with several control-surfaces and tabs. The input data for the deflection modes may consist of measured values. These are treated by a subprogram that fits a function with suitable edge characteristics to the data for each mode. Numerical results are given for several configurations. Comparisons for simple modes with results of other methods show close agreement in most cases. Author

N75-10011 European Space Research Organization, Paris (France).

AEROSPACE RESEARCH Bimonthly Bulletin No. 1973-4 Sep. 1974 129 p refs Transl. into ENGLISH of La Rech. Aerospaciale, Bull. Bimestriel No. 1973-4, ONERA, 1973 (ESRO-TT-90) Avail: NTIS HC \$5.75; ONERA, Paris 20 F

Topics in aerodynamics and materials are presented. A large scale leading edge method was applied, in a water tunnel to determine two dimensional flow distribution. Various methods of visualizing the flow in wind tunnels were applied to an airfoil having a high rate of curvature at the leading edge and a separation bubble at incidence. The modifications of a light element microanalyzer are discussed. The equipment to investigate the thermal decomposition of an ablative material is detailed. The lifting surface theory was applied to fixed wings and propellers. Spectral density curves in wind tunnel flutter measurements are analyzed.

N75-10012 European Space Research Organization, Paris (France).

ON THE FLOW AROUND THE LEADING EDGE OF AN AEROFOIL

Henri Werle *In its* Aerospace Res. (ESRO-TT-90) Sep. 1974 p 1-40 refs Transl. into ENGLISH from La Rech. Aerospaciale, Bull. Bimestriel No. 1973-4, 1973, p 197-218

In a water tunnel, the large scale leading edge method was successfully applied to the physical study of two dimensional flows which had previously been the subject of visualization on complete models. The phenomena occurring at the leading edge of an airfoil are analyzed, together with their evolution as a function of the angle of attack and other parameters. Tests reveal the location of the stagnation point, the extent of the separation, and the effectiveness of the means used to reduce or avoid it: suction, blowing, leading edge slats, rotation, etc.

Author (ESRO)

N75-10013 European Space Research Organization, Paris (France).

METHODS OF VISUALIZING THE LEADING EDGE SEPARATION BUBBLE AND ANALYSIS OF THE RESULTS c34

Emile Erlich *In its* Aerospace Res. (ESRO-TT-90) Sep. 1974 p 41-53 refs Transl. into ENGLISH from La Rech. Aerospaciale, Bull. Bimestriel No. 1973-4, 1973, p 219-223

Various methods of visualizing the flow in wind tunnels were used on an airfoil having a high rate of curvature at the leading edge (peaky) and which at incidence presented a separation bubble (short bubble). Visualization by means of sublimate or viscous coatings, and by a colored reagent, complemented each other to define the positions of the separation point, transition point within the bubble, and reattachment point. Visualization tests in a water tunnel also served to complement this data.

Author (ESRO)

N75-10016 European Space Research Organization, Paris (France).

LIFTING SURFACE THEORY APPLIED TO FIXED WINGS AND PROPELLERS

Rolland Dat *In its* Aerospace Res. (ESRO-TT-90) Sep. 1974 p 95-116 refs Transl. into ENGLISH from La Rech. Aerospaciale, Bull. Bimestriel No. 1973-4, 1973, p 245-254

An integral equation is formulated which defines the velocity potential induced by a lifting surface in arbitrary motion within a fluid. This equation can be applied to fixed wings, propellers, or rotary wings, and permits the treatment of problems or aeroelasticity of these structures using methods that are known to be effective for the prediction of aircraft flutter.

Author (ESRO)

N75-10020 Aeronautical Research Inst. of Sweden, Stockholm. **EVALUATION OF THE ACCURACY OF TWO HELICOPTER ROTOR THEORIES**

B. C. A. Johansson May 1974 150 p refs Sponsored by Swed. Mater. Admin. (FFA-124) Avail: NTIS HC \$5.75; Almqvist & Wiksell Sw.Kr.40

The accuracy of two helicopter rotor or propeller theories is examined by comparison with experiments and with older theories. The accuracy of the first theory is found to be satisfactory. The second theory shows good agreement with other disk approximation theories. It is also found that the use of the disk approximation gives a too small induced downwash at the locations of the blades, in particular when the blades are few. Author (ESRO)

N75-10021 Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

THE NATURE, DEVELOPMENT AND EFFECT OF THE VISCOUS FLOW AROUND AN AEROFOIL WITH HIGH-LIFT DEVICES

D. N. Foster, P. R. Ashill, and B. R. Williams London Aeron. Res. Council 1974 52 p refs Supersedes RAE-TR-72227; ARC-34436 (ARC-CP-1258; RAE-TR-72227; ARC-34436) Avail: NTIS HC \$4.25; HMSO 80p; PHI \$3.35

The nature of the viscous flow around an airfoil with high-lift devices is described. A method of calculating the development of the viscous layers is considered. The contributions of the wing wake and flap boundary layer to the lift carried by the components of the multiple airfoil were examined. The manner in which the viscous layers may be incorporated into a calculation of the loading on the airfoil is discussed. Author (ESRO)

N75-10022# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

THE DESIGN OF A SERIES OF WARPED SLENDER WINGS FOR SUBSONIC SPEEDS

Patricia J. Davies London Aeron. Res. Council 1974 87 p refs Supersedes RAE-TR-71173; ARC-33723 (ARC-CP-1263; RAE-TR-71173; ARC-33723) Avail: NTIS HC \$4.75; HMSO £1.35; PHI \$5.30

The derivation of warped (cambered and twisted) mean surfaces is described for a series of wind tunnel models of low aspect ratio wings with pointed apexes, 'mild-gothic' planforms and sharp leading edges. The primary aim was to obtain higher ratios of lift to drag than those of the plane wing while maintaining the same orderly development of the flow. Subsidiary aims were to assess how far performance might be compromised by varying the center of pressure of the wing and by shaping it to reduce the lateral propagation of noise from an overwing engine installation. The mathematical basis is the linearized theory of subsonic flow. The shapes and pressure distributions of the models are shown. Author (ESRO)

N75-10023# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

A CALCULATION METHOD FOR THE TWO DIMENSIONAL TURBULENT FLOW OVER A SLOTTED FLAP

H. P. A. H. Irwin London Aeron. Res. Council 1974 54 p refs Supersedes RAE-TR-72124; ARC-34236 (ARC-CP-1267; RAE-TR-72124; ARC-34236) Avail: NTIS HC \$4.25; HMSO 80p; PHI \$3.35

An integral calculation method for the two dimensional turbulent flow over a slotted flap is described, which takes into account the interaction of the wake from the main airfoil with the boundary layer on the flap, and the variation of static pressure normal to the flap surface. The results were compared with experiment, and it was found that the method gives good agreement with the measured variation of the integral properties of the wake and boundary layer, and with the measured skin friction. The limitations of the method are discussed briefly in relation to the more complex approach of a differential method.

Author (ESRO)

N75-10024# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.

A CALCULATION METHOD FOR THE TURBULENT BOUNDARY LAYER ON AN INFINITE YAWED WING IN COMPRESSIBLE, ADIABATIC FLOW

P. D. Smith London Aeron. Res. Council 1974 27 p refs Supersedes RAE-TR-72193; ARC-34388 (ARC-CP-1268; RAE-TR-72193; ARC-34388) Avail: NTIS HC \$3.75; HMSO 45p; PHI \$1.95

A method is presented for the calculation of the compressible turbulent boundary layer both at the attachment line and over the surface of an infinite, yawed, thermally-insulated wing. The method uses the momentum integral and entrainment equations for three-dimensional compressible flow. A FORTRAN computer program, based upon the method, was written to calculate the boundary layer development on an infinite yawed wing of given section shape, sweep, and pressure distribution at a given Reynolds number, Mach number, stagnation temperature, and transition position. Author (ESRO)

N75-10025# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.

THE EXTERNAL DRAG OF FUSELAGE SIDE INTAKES: RECTANGULAR INTAKES WITH COMPRESSION SURFACES VERTICAL

M. D. Dobson London Aeron. Res. Council 1974 80 p refs Supersedes RAE-TR-72202; ARC-34455 (ARC-CP-1269; RAE-TR-72202; ARC-34455) Avail: NTIS HC \$4.75; HMSO £1.25; PHI \$4.90

Measurements of the external drag of rectangular intakes installed on the sides of a fuselage are presented. Results at subsonic speeds show that drag at full flow is independent of compression surface geometry. Substantial flow spillage may be achieved for little drag penalty provided that the intake throat Mach number is kept high by elevation of the compression surface. Spillage drag was found to be uniquely related to the inlet mass flow ratio (as distinct from capture mass flow ratio). Radius of the cowl lip was found to affect the drag of the intake at full flow but becomes less important as flow is reduced. Drag at full flow for intakes with swept end walls is lower than for a configuration in which they are unswept but the spillage drag rise is greater. At supersonic speeds the variation in full flow drag with compression surface geometry may be predicted from consideration of the changes in shock geometry but there is generally a small positive increment which is not accounted for in the calculation. Calculation methods based on theoretical shock geometry are found to over estimate spillage drag.

Author (ESRO)

N75-10026# Aircraft Research Association, Ltd., Bedford (England).

RESULTS OF A SERIES OF WIND TUNNEL TESTS ON THE VICTOR B.Mk.2 AIRCRAFT AND A COMPARISON WITH DRAG ESTIMATES AND FULL SCALE FLIGHT DATA

J. I. Simper London Aeron. Res. Council 1974 54 p refs Supersedes ARC-33227 (Contract MIN-TEC-KC-49/25/CB/5/D) (ARC-CP-1283; ARC-33227) Avail: NTIS HC \$4.25; HMSO 85p; PHI \$3.55

Wind tunnel measurements of drag for a 1/25 scale model of the Victor B.Mk.2 were compared with estimates and flight data. At wind tunnel Reynolds numbers, reasonable agreement is shown to exist between the estimated drag and an extrapolation to $M = 0$, $C_{sub L} = 0$ from the lowest test Mach number and moderate $C_{sub L}$ of the measured complete model drag. At full scale Reynolds numbers the standard of agreement between the extrapolated wind tunnel and full scale flight drag data is shown to depend on whether the wind tunnel or flight derived values are used, and the assumed drag of small excrescences not represented on the model. If certain assumptions are made then at low and moderate $C_{sub L}$ good agreement is shown to exist between the extrapolated wind tunnel and flight measured drags, and the wind tunnel tends to predict a later drag-rise than that measured in flight by delta $M = 0.015$ or less depending on the assumptions made.

Author (ESRO)

N75-10028# Cambridge Univ. (England). Dept. of Engineering.

PRESSURE DISTRIBUTION ON TWO WINGS WITH CURVED LEADING EDGES AT SUPERSONIC SPEEDS

K. Yegnanarayan London 1974 48 p refs Supersedes ARC-34293 Sponsored by Churchill Coll. (ARC-R/M-3741; ARC-34293) Avail: NTIS HC \$3.75; HMSO £1.66; PHI \$6.75

Results are presented of a pressure study on the flat windward surfaces of two wings with curved, sharp leading edges. The leading edges of one of the wings are convex outwards, whereas those of the second are concave outwards. The wings were tested at nominal free stream Mach numbers of 2.5, 3.5 and 4.5. The results indicate that the changes in flow development due to the curvature of the leading edges are qualitatively similar at all the Mach numbers. In the case of the first wing, the spanwise pressure distribution changed considerably as the flow developed downstream of the vortex; however, the changes in the spanwise pressure distribution on the wing with concave leading edge, though observable, were much less. The pressure distribution on the two wings was calculated using the concept of an equivalent delta wing, but modified to take into account the upstream effect. Comparisons with experiments show that the agreement is fairly good, except at very high incidences and

over the outer half of the semi-span. Possible reasons for this discrepancy are discussed. An attempt was made to justify the definition of an equivalent delta wing based on a simple physical idea. Author (ESRO)

N75-10029# Royal Aircraft Establishment, Farnborough (England). Structures Dept.

SOME CALCULATIONS FOR AIR RESONANCE OF A HELICOPTER WITH NON-ARTICULATED ROTOR BLADES
J. C. A. Baldock London ARC 1974 33 p refs Supersedes RAE-TR-72083; ARC-34332

(ARC-R/M-3743; RAE-TR-72083; ARC-34332) Avail: NTIS HC \$3.75; HMSO £ 1.20; PHI \$4.90

An analysis of air resonance in the hover, and the solutions obtained for a helicopter with nonarticulated blades are described. It is shown that stability in air resonance depends critically on blade structural and aerodynamic parameters that are not easily estimated with the required accuracy and that a calculation technique requires careful, positive correlation with experiment before its accuracy can be accepted. The effectiveness of model rotor experiments for checking data was considered, and measurements of rotor impedances show promise of providing a useful basis for comparing with theoretical equivalents. The effect of an autostabilizer designed to counteract the conventional helicopter instabilities in pitch and roll was investigated. It was found that such an autostabilizer destabilizes the air resonance mode. Author (ESRO)

N75-10030# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

LOW-SPEED WING-TUNNEL MEASUREMENTS OF THE LIFT, DRAG AND PITCHING MOMENT OF A SERIES OF CROPPED DELTA WINGS

D. A. Kirby London ARC 1974 41 p refs Supersedes RAE-TR-72211; ARC-34598

(ARC-R/M-3744; RAE-TR-72211; ARC-34598) Avail: NTIS HC \$3.75; HMSO £ 1.45; PHI \$5.80

Measurements of lift, drag and pitching moment were made on a series of cropped delta wings of aspect ratio 1.4, 1.2, 1.0 and 0.8 formed successively cropping a delta wing model of aspect ratio 1.6. These tests extended earlier work on sharp-edged slender wings of the same chordwise section and maximum thickness/chord ratio, 4 0/6. Empirical curves were derived for predicting the low speed characteristics of slender wings at zero sideslip and test results on the cropped series were analyzed and compared with correlation curves. Differences were noted linked with the improved performance of a cropped delta compared with a pure delta planform of the same aspect ratio.

Author (ESRO)

N75-10031# European Space Research Organization, Paris (France).

ESTIMATION OF THE CHARACTERISTICS OF VARIOUS FLARE PROFILES

Manfred Rodewald Sep. 1974 41 p refs Transl. into ENGLISH of Abschaetzungen des prinzipiellen Verlaufs verschiedener Abfangbahnen, DLR-FB-74-21, DFVLR, 7 FEB. 1974

(ESRO-TT-89; DLR-FB-74-21) Avail: NTIS HC \$3.75; DFVLR, Porz, West Ger. 11 DM

Exponential, parabolic, and optimum flare profiles were investigated for a simplified aircraft model. It is shown that increasing approach speeds and flight path angles require an extended flare phase. It is concluded that appropriately designed flare profiles allow for higher approaches. ESRO

N75-10033 California Univ., Los Angeles.

A METHODOLOGY FOR DETERMINING THE FLIGHT SYSTEM MIX OF AN AIR TRANSFER ROUTE STRUCTURE
Ph.D. Thesis

Harold Eugene Roland, Jr. 1974 351 p
Avail: Univ. Microfilms Order No. 74-22959

A modeling process is reported which is of immediate and primary use to the air carriers in determining their aircraft flight system mix for the long term profitability of their operating route

structure. The principal exogenous variables are demand for service and technology level. The model is discrete and considers the majority of constraints imposed on such a system. The model can assimilate real aircraft in service today as well as higher technology aircraft of the future. The model serves both passenger and cargo demand with either a pair or triplet of aircraft. The triplet may occur on international routes where the third aircraft is a supersonic transport interacting competitively with subsonic transports. The model incorporates a fuel cost variation process with feedback loops to adjust both fare and demand. This feature allows an increase in fuel cost by an annual percentage greater than the general inflation rate of the remaining elements.

Dissert. Abstr.

N75-10034# Committee on Appropriations (U. S. Senate).

PROPOSED INTERNATIONAL AIR SHUTTLE, 1975

Washington GPO 1974 243 p refs Hearing before Subcomm. on Treasury, Postal Service, and General Govt. of Comm. on Appropriations, 93d Congr., 2d Sess., 20 Mar. 1974

(GPO-31-527) Avail: Subcomm. on Treasury, Postal Service, and General Govt.

Recommendations that a chartered international air shuttle be established to transport DOD and official government personnel on overseas assignments, in order to eliminate tariff inconsistencies and unfairness, was debated before Congress. Information was submitted by the major airlines which reflected their concern that a duplication of services would adversely impact their operations, and that the air shuttle would cut into the already short supply of fuel available for aviation purposes. A.A.D.

N75-10035# National Transportation Safety Board, Washington, D.C.

THE ATTAINABLE GOAL IN AIRLINE SAFETY

John H. Reed 9 May 1974 10 p Presented at the spring meeting of the Assoc. of Local Transport Airlines, Toronto, 9 May 1974

Avail: NTIS HC \$3.25

The safety record of scheduled air carrier service for the past 10 years is reviewed against a background of constant operational growth. It is shown that accident rates and fatality rates reveal a slightly downward trend. Evaluation of local airline fatal accidents establishes as primary causes: (1) pilot error; (2) other personnel errors; and (3) inclement, foggy weather conditions. The information loop between airlines, manufacturers, and the Federal Aviation Administration is the greatest single factor in air transportation safety. G.G.

N75-10036*# Scientific Translation Service, Santa Barbara, Calif.
OPERATIONAL EFFECTIVENESS OF TRANSPORT AIRCRAFT

N. N. Smirnov and I. K. Mulikidzhanov Washington NASA Sep. 1974 316 p refs Transl. into ENGLISH of the book "Ekspluatatsionnaya Tekhnologichnost Transportnykh Samoletov" Moscow, Transport Press, 1972 208 p.

(Contract NASw-2483)

(NASA-TT-F-810) Avail: NTIS HC \$9.25 CSCL 01C

Problems in the theory and practice of maintainability of transport aircraft, considering the developmental trends in their maintenance and overhaul are discussed. Factors which determine maintainability, a system of quantitative indices for estimating maintainability, and methods of performing a technical determination of the indices are analyzed. The problems of establishing the general requirements for aviation technology, methods of collecting the necessary information, and methods of evaluating maintainability of aircraft during their operation and tests are discussed. Author

N75-10037# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.

ANNUAL REVIEW OF AIRCRAFT ACCIDENT DATA: US GENERAL AVIATION CALENDAR YEAR 1971

29 May 1974 200 p

(NTSB-ARG-74-2) Avail: NTIS HC \$7.00 CSCL 01C

The Annual Review of Aircraft Accident Data is a statistical compilation published by the National Transportation Safety Board.

The publication contains statistical information compiled from reports of 4,648 General Aviation accidents that occurred during the calendar year 1971. Included in the total number of accidents are 51 collisions between aircraft. By coding each aircraft involved in the collisions, an additional 51 records are produced, bringing the total accidents records to 4,699. This figure reflects the true number of pilots and aircraft involved in the accidents.

Author

N75-10038*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMULATION STUDIES OF STOL AIRPLANE OPERATIONS IN METROPOLITAN DOWNTOWN AND AIRPORT AIR TRAFFIC CONTROL ENVIRONMENTS

Richard H. Sawyer and Milton D. McLaughlin Washington Nov. 1974 41 p refs
 (NASA-TN-D-7740; L-9663) Avail: NTIS HC \$3.75 CSCL 01E

The operating problems and equipment requirements for STOL airplanes in terminal area operations in simulated air traffic control (ATC) environments were studied. These studies consisted of Instrument Flight Rules (IFR) arrivals and departures in the New York area to and from a downtown STOL port, STOL runways at John F. Kennedy International Airport, or STOL runways at a hypothetical international airport. The studies were accomplished in real time by using a STOL airplane flight simulator. An experimental powered lift STOL airplane and two in-service airplanes having high aerodynamic lift (i.e., STOL) capability were used in the simulations.

Author

N75-10039# Oak Ridge National Lab., Tenn.
TOTAL ENERGY USE FOR COMMERCIAL AVIATION IN THE US

E. Hirst Apr. 1974 15 p refs
 (Contract W-7405-eng-26; Grant NSF AG-398)
 (ORNL-NSF-EP-68) Avail: NTIS HC \$3.25

The total energy impacts of commercial aviation in the United States are shown. Direct fuel use by commercial airplanes (1080 trillion Btu in 1971) amounts to 6% of direct fuel use for all domestic transportation, 1.6% of the total national energy budget. Indirect energy requirements are one-third as great as the direct fuel use. Thus, total energy demand for domestic commercial aviation in 1971 was 1450 trillion Btu, 2% of national energy use. Direct fuel savings due to adoption of airline conservation measures can be increased by one-third to account for the indirect energy savings. Some conservation measures, such as a reduction in short-haul flights, are likely to have larger energy savings, because short-haul flights involve higher maintenance costs, greater airport use, and higher passenger service costs on a passenger-mile basis than do longer flights. Other measures, such as reducing cruise speeds, are likely to have relatively small indirect energy savings. In all cases, the direct fuel savings can be increased by 20%. NSA

N75-10043# Royal Aircraft Establishment, Farnborough (England).
AUTOMATIC FLYING OF CURVED APPROACH PATHS: A COMPUTER AND FLIGHT INVESTIGATION

R. B. Lumsden and N. Cooke Feb. 1974 63 p refs
 (RAE-TR-73154; BR39684) Avail: NTIS HC \$4.25

Computer studies and flight experiments are described which indicate the feasibility of transport aircraft (as represented by the Comet 3B) flying automatic approaches on paths curved in azimuth and elevation. The flight paths considered have radii of curvature from 1800 m to 3000 m in azimuth and the glide paths have maximum gradients from 3 deg to 6 deg. The effects of various terms in the autopilot control laws are discussed, along with performance in varying wind conditions.

Author (ESRO)

N75-10046# Army Electronics Command, Fort Monmouth, N.J. Communications/ADP Lab.
INTERFERENCE WITH AIRCRAFT RADIO NAVIGATION AND COMMUNICATIONS BY PRECIPITATION STATIC FROM ICE AND SNOW CLOUDS: ELECTROSTATIC WIND

TUNNEL EXPERIMENTS Final Report, Mar. - Jul. 1974

Kurt Ikrath Aug. 1974 43 p refs
 (DA Proj. 1T1-61101-A-91A)
 (AD-784623; ECOM-4244) Avail: NTIS CSCL 20/14

The effects of precipitation static noise interference with the reception of radio navigation and communication signals on aircraft flying through ice and snow clouds were generated with an electrostatic wind tunnel. Electrical type antennas were found to be highly susceptible to precipitation static noise fields, whereas magnetic antennas were found to be practically immune to these noise fields unless the magnetic antennas were in close proximity to metal surfaces.

Author (GRA)

N75-10052 Mashinstoyeniye, Moscow (USSR).
TABULATED VALUES OF COMBINATIONS OF CYCLIC AND HYPERBOLIC FUNCTIONS

I. V. Ananyev and N. I. Yegorsheva 1974 322 p In RUSSIAN

Copyright. Avail: Issuing Activity

Tables are presented for cyclic and hyperbolic functions which are important in the calculation of oscillations and the stability of construction elements in aircraft. The tables are composed on the assumption that small intervals from zero to six radians allow the calculation of the fundamental oscillations of elements in aviation construction and higher frequencies.

Author

N75-10053# Advisory Group for Aerospace Research and Development, Paris (France).
CRITICAL REVIEW OF METHODS TO PREDICT THE BUFFET CAPABILITY OF AIRCRAFT

Helmut John (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich) Sep. 1974 33 p refs
 (AGARD-R-623) Avail: NTIS HC \$3.75

A general survey of methods for predicting the buffet penetration capability of aircraft of various configurations is presented. The influence that limiting factors may have on the performance of a fighter aircraft is analyzed. The sensitivity of turn rates at subsonic, transonic, and supersonic speeds are examined. The effects on structural aspects to include fatigue life of the airframe and weapon system performance are explained. Graphs of typical buffeting conditions are included.

Author

N75-10054*# Advisory Group for Aerospace Research and Development, Paris (France).
TRANSONIC BUFFET BEHAVIOR OF NORTHROP F-5A AIRCRAFT

Chintsun Hwang (Northrop Corp., Hawthorne, Calif.) and W. S. Pi (Northrop Corp., Hawthorne, Calif.) Sep. 1974 33 p refs
 (Contract NAS2-6475)
 (NASA-CR-140939; AGARD-R-624) Avail: NTIS HC \$3.75 CSCL 01C

Flight tests were performed on an F-5A aircraft to investigate the dynamic buffet pressure distribution on the wing surfaces and the responses during a series of transonic maneuvers called wind-up turns. The conditions under which the tests were conducted are defined. The fluctuating buffet pressure data on the right wing of the aircraft were acquired by miniaturized semiconductor-type pressure transducers flush mounted on the wing. Processing of the fluctuating pressures and responses included the generation of the auto- and cross-power spectra, and of the spatial correlation functions. An analytical correlation procedure was introduced to compute the aircraft response spectra based on the measured buffet pressures.

Author

N75-10055*# Kanner (Leo) Associates, Redwood City, Calif.
CRITICAL ANALYSES AND LABORATORY RESEARCH WORK AT THE STAGE OF AIRCRAFT PRELIMINARY DESIGN

C. Lievens and P. Poisson-Quinton Washington NASA Oct. 1974 62 p Transl. into ENGLISH from the AGARD report AGARD-CP-147-Vol-1
 (Contract NASw-2481)
 (NASA-TT-F-15996; AGARD-CP-147-Vol-1) Avail: NTIS HC \$4.25 CSCL 01C

At the preliminary aircraft design stage, the design offices rely simultaneously on experience gained with previous projects.

sophisticated computations, results of tests ordered from laboratories, a well informed documentation center, and the intuitive faculties of the project officer. On the other hand, the research center must forecast the main trends of aeronautical techniques in due time, in order to provide the government services and the manufacturers with the maximum of information. But it should also possess a very short response time capability in order to satisfy urgent requests. This requirement calls for large resources, as far as specialized manpower and up-to-date laboratories are concerned. Author

**N75-10056*# Kanner (Leo) Associates, Redwood City, Calif.
INTERFERENCE OF A SWEEPBACK WING AND THE
FUSELAGE AT TRANSONIC SPEEDS**

L. A. Potapova Washington NASA Oct. 1974 8 p refs
Transl. into ENGLISH from Uch. Zap. TsAGI (USSR), v. 4, no. 3, 1974 p 101-104
(Contract NASw-2481)

(NASA-TT-F-15993) Avail: NTIS HC \$3.25 CSCL 01B

Calculation results are presented for the interference of a flat sweptback wing and a cylindrical fuselage at transonic speeds and small angles of attack. A random law of spanwise load distribution is used. Results are graphically presented and compared with experimental data. Author

**N75-10057*# National Aeronautics and Space Administration,
Ames Research Center, Moffett Field, Calif.**

**OPTIMAL CONTROL THEORY INVESTIGATION OF PROP-
ROTOR/WING RESPONSE TO VERTICAL GUST**

Juanita K. Frick and Wayne Johnson Sep. 1974 118 p refs
Prepared in cooperation with Army Air Mobility R and D Lab.,
Moffett Field, Calif.

(NASA-TM-X-62384) Avail: NTIS HC \$5.25 CSCL 01C

Optimal control theory is used to design linear state variable feedback to improve the dynamic characteristics of a rotor and cantilever wing representing the tilting proprotor aircraft in cruise flight. The response to a vertical gust and system damping are used as criteria for the open and closed loop performance. The improvement in the dynamic characteristics achievable is examined for a gimbaled rotor and for a hingeless rotor design. Several features of the design process are examined, including: (1) using only the wing or only the rotor dynamics in the control system design; (2) the use of a wing flap as well as the rotor controls for inputs; (3) and the performance of the system designed for one velocity at other forward speeds. Author

**N75-10058*# National Aeronautics and Space Administration,
Ames Research Center, Moffett Field, Calif.**

**TECHNIQUES FOR IMPROVING THE STABILITY OF SOFT
INPLANE HINGELESS ROTORS**

Robert A. Ormiston Oct. 1974 58 p refs Prepared in cooperation
with Army Air Mobility R and D Lab., Moffett Field, Calif.
(NASA-TM-X-62390) Avail: NTIS HC \$4.25 CSCL 01C

The influence of basic parameters that govern flap lag stability of hingeless rotor blades in hover is reviewed, and potential methods are studied for improving the lead lag damping of soft inplane configurations for low thrust conditions. These conditions are relevant for ground and air resonance stability of coupled rotor body dynamic systems. Results indicate that the isolated rotor blade lead lag damping can be usefully increased by a combination of flap lag elastic coupling and pitch lag coupling. For a typical soft inplane configuration, 6% of critical damping can be obtained for moderate pitch lag coupling. For large values of the coupling parameters, the lead lag frequency is substantially reduced at high pitch angles and airfoil stall effects also reduce the lead lag damping. Author

**N75-10059*# Kanner (Leo) Associates, Redwood City, Calif.
PERFORMANCE IMPROVEMENT THROUGH CONTROL
CONFIGURED VEHICLE CONCEPT**

G. Loebert Washington NASA Nov. 1974 37 p refs Transl.
into ENGLISH from the German reports DGLR-72-094 and
UFE-895-72(OE)

(Contract NASw-2481)

(NASA-TT-F-15998; DGLR-72-094; UFE-895-72(OE)) Avail:
NTIS HC \$3.75 CSCL 01C

The possibility of obtaining high potential power increases at only small additional costs by employing artificial instead of natural stabilization is demonstrated. It is shown that if the requirement of static aerodynamic stability is eliminated, the drag polars and thus flight performance can be significantly improved. This improvement occurs mainly in the form of an increase in specific excess power at high lift coefficients and in an increase in the attainable maximum lift coefficients. The dynamic flight characteristics of such aircraft can be made equal to or better than the characteristics of aerodynamically stable aircraft through appropriate artificial stabilization. By incorporating suitable redundancies and other provisions, the flight safety of conventional mechanically controlled aircraft can be achieved. Author

**N75-10060*# Kanner (Leo) Associates, Redwood City, Calif.
THE CCV CONCEPT AND SPECIFICATIONS**

J. C. Wanner Washington NASA Oct. 1974 19 p Transl.
into ENGLISH from the AGARD report AGARD-CP-147-Vol-1
(Contract NAS-2481)

(NASA-TT-F-15997; AGARD-CP-147-Vol-1) Avail: NTIS HC
\$3.25 CSCL 01C

The CCV concept consists in taking into account, at the design stage of a new aircraft, the possibilities offered by four systems: Static stability compensation, maneuver load control, active ride control and active flutter control. The CCV concept could be summed up as follows: To take advantage of the latest technical advances in electronics and to make use of new types of control surfaces to make the optimum compromise between performance, handling qualities, lifetime and cost. One of the results of this philosophy is the abandonment of aircraft natural stability requirements. Author

**N75-10061*# National Aeronautics and Space Administration,
Langley Research Center, Langley Station, Va.**

**ANALYSIS OF A FLARE-DIRECTOR CONCEPT FOR AN
EXTERNALLY BLOWN FLAP STOL AIRCRAFT**

David B. Middleton Washington Nov. 1974 25 p refs
(NASA-TN-D-7760; L-9572) Avail: NTIS HC \$3.25 CSCL
01C

A flare-director concept involving a thrust-required flare-guidance equation was developed and tested on a moving-base simulator. The equation gives a signal to command thrust as a linear function of the errors between the variables thrust, altitude, and altitude rate and corresponding values on a desired reference flare trajectory. During the simulator landing tests this signal drove either the horizontal command bar of the aircraft's flight director or a thrust-command dot on a head-up virtual-image display of a flare director. It was also used as the input to a simple autoflare system. An externally blown flap STOL (short take-off and landing) aircraft (with considerable stability and control augmentation) was modeled for the landing tests. The pilots considered the flare director a valuable guide for executing a proper flare-thrust program under instrument-landing conditions, but were reluctant to make any use of the head-up display when they were performing the landings visually. Author

**N75-10062*# National Aeronautics and Space Administration,
Flight Research Center, Edwards, Calif.**

**EXPERIMENTAL DETERMINATION OF AIRPLANE MASS
AND INERTIAL CHARACTERISTICS**

Chester H. Wolowicz and Roxanah B. Yancey Washington Oct.
1974 66 p refs

(NASA-TR-R-433; H-814) Avail: NTIS HC \$4.25 CSCL 01C

Current practices are evaluated for experimentally determining airplane center of gravity, moments of inertia, and products of inertia. The techniques discussed are applicable to bodies other than airplanes. In pitching- and rolling-moment-of-inertia investigations with the airplane mounted on and pivoted about knife edges, the nonlinear spring moments that occur at large amplitudes of oscillation can be eliminated by using the proper spring configuration. The single-point suspension double-pendulum technique for obtaining yawing moments of inertia, products of inertia, and the inclination of the principal axis provides accurate results from yaw-mode oscillation data, provided that the sway-mode effects are minimized by proper suspension rig design. Rocking-mode effects in the data can be isolated. Author

N75-10063# Boeing Vertol Co., Philadelphia, Pa.
MODEL 301 HLH/ATC (HEAVY LIFT HELICOPTER/ADVANCED TECHNOLOGY COMPONENT) TRANSMISSION NOISE REDUCTION PROGRAM Final Report
 R. Hartman and R. Bagley May 1974 175 p refs
 (Contract DAAJ01-71-C-0840)
 (AD-784132; USAAMRDL-TR-74-58) Avail: NTIS CSCL 01/3

The report presents the results of a transmission noise reduction program. The emphasis of the program is to reduce transmission noise at its source. The program included a dynamic test of a CH-47C helicopter transmission with internal instrumentation to measure strains, displacements, and accelerations of rotating components and external instrumentation to measure case acceleration and noise levels. Test results were used to verify prediction methodology which in turn was used to analyze the dynamic response of the Heavy Lift Helicopter (HLH) transmission components. (Modified author abstract) GRA

N75-10064# McDonnell-Douglas Corp., St. Louis, Mo.
HIGH ACCELERATION COCKPITS FOR ADVANCED FIGHTER AIRCRAFT. VOLUME 1: PROGRAM SUMMARY Final Report, 1 Apr. - 14 Dec. 1973
 James M. Sinnett May 1974 56 p refs
 (Contract F33615-73-C-3067; AF Proj. 6190)
 (AD-783600; MDC-A2631-Vol-1; AFFDL-TR-74-48-Vol-1) Avail: NTIS CSCL 01/3

A high acceleration cockpit design integration program was conducted for an advanced fighter concept with direct lift and direct side force capabilities. Program efforts included an assessment of basic pilot tasks in fighter mission, using the configuration direct force and high acceleration design features. Cockpit functional capabilities were tailored to satisfy operational needs, providing for normal flight and combat phases of the mission. Several configuration design alternatives were evaluated by USAF pilots in a static simulation cockpit evaluation phase. Resulting objective and subjective measures allowed ranking of configuration concepts. Several principal areas for future high acceleration cockpit development were defined. Author (GRA)

N75-10065# McDonnell-Douglas Corp., St. Louis, Mo.
HIGH ACCELERATION COCKPITS FOR ADVANCED FIGHTER AIRCRAFT. VOLUME 2: CREW STATION DESIGN/INTEGRATION Final Report, 1 Apr. - 14 Dec. 1973
 Robert E. Mattes, Leslie N. Edgington, and James Roberts, Jr. May 1974 79 p refs
 (Contract F33615-73-C-3067; AF Proj. 6190)
 (AD-783601; MDC-A2631-Vol-2; AFFDL-TR-74-48-Vol-2) Avail: NTIS CSCL 01/3

A high acceleration cockpit design integration program was conducted for an advanced fighter concept with direct lift and side force capabilities. Program efforts included an assessment of required cockpit controls and displays considering both functional requirements and basic pilot tasks in a fighter mission. Cockpit functional capabilities were tailored to satisfy operational needs considering the integration of an articulating ejection seat and fly-by-wire side arm controllers. Several configuration design alternatives were constructed for subsequent evaluation by USAF pilots in a static design aid evaluation phase. (Modified author abstract) GRA

N75-10066# McDonnell-Douglas Corp., St. Louis, Mo.
HIGH ACCELERATION COCKPITS FOR ADVANCED FIGHTER AIRCRAFT. VOLUME 3: TEST PLAN Final Report, 1 Apr. - 14 Dec. 1973
 Carl F. Asiala and Thomas J. Quinn May 1974 65 p refs
 (Contract F33615-73-C-3067; AF Proj. 6190)
 (AD-783602; MDC-A2631-Vol-3; AFFDL-TR-74-48-Vol-3) Avail: NTIS CSCL 01/3

A high acceleration cockpit design and integration program was conducted, using a full scale design aid. Alternate configurations were compared using this full scale design aid in a formally structured evaluation including mission related task elements. Crew station characteristics were thus related to

operator needs in a mission context for advanced fighter concepts. Author (GRA)

N75-10067# McDonnell-Douglas Corp., St. Louis, Mo.
HIGH ACCELERATION COCKPITS FOR ADVANCED FIGHTER AIRCRAFT. VOLUME 4: TEST RESULTS Final Report, 1 Apr. - 14 Dec. 1973
 Carl F. Asiala and Thomas J. Quinn May 1974 93 p refs
 (Contract F33615-73-C-3067; AF Proj. 6190)
 (AD-783603; MDC-A2631-Vol-4; AFFDL-TR-74-48-Vol-4) Avail: NTIS CSCL 01/3

A high acceleration cockpit design test/evaluation program was conducted, using a full scale design aid. Alternate configurations were compared using this full scale design aid in a formally structured evaluation including mission related task elements. Test criteria considered evaluation of control/display and cockpit design options, including seat location, motion, and pilot anthropometry, with a balance between the physical and operational test measures and objectives using Air Force provided pilot subjects. Author (GRA)

N75-10069# Kaman Aerospace Corp., Bloomfield, Conn.
ELASTIC PITCH BEAM TAIL ROTOR OPERATIONAL SUITABILITY INVESTIGATION Final Report
 Alfred S. Falcone, Frank Clark, and Paul Maloney Jul. 1974 129 p refs
 (Contract DAAJ02-71-C-0063; DA Proj. 1F2-62203-AH-86)
 (AD-784595; R-1207; USAAMRDL-TR-74-60) Avail: NTIS CSCL 01/3

The work under this contract was performed to ascertain the operational suitability of the Elastic Pitch Beam Tail Rotor being developed under Contract DAAJ02-72-C-0006 and to enhance its performance by selection of an optimized protective coating system and leading-edge erosion guard. Adiprene L-167 was selected for the protective coating based on the protection afforded to the GRP substrate in reverse-bending fatigue under cyclic environmental exposure of humidity, solar simulation, cold, and heat. Spring rate test performed on the GRP spar assembly at various levels of CF loading from -65F to 160F with and without exposure to environmental cycling disclosed spring rate changes within 15 percent for the temperature extreme tested. (Modified author abstract) GRA

N75-10070# Air Force Armament Lab., Eglin AFB, Fla.
AERODYNAMIC SYMMETRY OF AIRCRAFT AND GUIDED MISSILES Final Report, Jul. - Dec. 1974
 Peter H. Zipfel Jul. 1974 23 p
 (AD-784254; AFATL-TR-74-121) Avail: NTIS CSCL 01/1

A theory is developed that takes advantage of the inherent configurational symmetries of aircraft and guided missiles to eliminate some force and moment derivatives. Starting with the Principle of Material Indifference, tensor analysis is employed to derive two simple conditions for vanishing aerodynamic derivatives. The results apply to derivatives of arbitrary order, taken with respect to linear and angular velocities, linear accelerations, and control surface deflections. Two charts are presented that sift out the vanishing derivatives up to second order for missiles with tetragonal symmetry and up to third order for aircraft with reflectional symmetry. Author (GRA)

N75-10071# Texas Instruments, Inc., Dallas. Equipment Group.
A CONCEPTUAL DEFINITION STUDY FOR A DIGITAL AVIONICS INFORMATION SYSTEM (APPROACH 2), VOLUME 1 Final Report, 1 Feb. - 30 Jun. 1973
 C. T. Brodnax Mar. 1974 376 p refs
 (Contract F33615-73-C-1156)
 (AD-780581/5; AFAL-TR-73-427-Vol-1) Avail: NTIS HC \$10.25 CSCL 01/3

The report covers the digital avionics information system (DAIS) definition study which was intended to define the concepts for low cost avionics for the 1980s aircraft. ADAIS core was defined to consist of processor ensemble, controls/displays, information transfer system, and software. The application of this core to solve the avionics problems was addressed and the required characteristics of each core element defined. In addition

to solving the avionics problems, it was found that the DAIS core had great potential for increasing systems maintenance capability while reducing AGE requirements. DAIS must be designed to meet these requirements, as opposed to adding onto an existing system, if the full capability is to be achieved.

Author (GRA)

N75-10072# Texas Instruments, Inc., Dallas. Equipment Group.

A CONCEPTUAL DEFINITION STUDY FOR A DIGITAL AVIONICS INFORMATION SYSTEM (APPROACH 2). VOLUME 2: APPENDIXES A THRU D Final Report, 1 Feb. - 30 Jun. 1973

C. T. Brodnax Mar. 1974 457 p refs

(Contract F33615-73-C-1156)

(AD-780582/3; AFAL-TR-73-427-Vol-2) Avail: NTIS HC \$11.50 CSCL 01/3

The components of a digital avionics information system are analyzed. The subjects discussed are: (1) parameter transformation matrix, (2) mathematics flow, (3) display/control partitioning and control panel data sheets, and (4) display/control interaction matrices.

Author

N75-10073# Ohio State Univ., Columbus. Dept. of Mechanical Engineering.

DEVELOPMENT OF ACCELERATED LIFE TESTING TECHNIQUES FOR GENERAL FAILURE MODES OF AIRCRAFT HARDWARE Final Report, 1 Jan. - 31 Dec. 1973

Jack A. Collins and Ben Tarver Hagan, Jr. May 1974 330 p refs

(Contract DAAJ02-73-C-0023; DA Proj. 1F1-62203-A-119)

(AD-784188; USAAMRDL-TR-74-36) Avail: NTIS CSCL 01/3

The objective of the investigation was to determine the feasibility of developing reliable accelerated life testing methods for aircraft hardware, based on currently documented failure case histories. Over 240 case histories involving more than 500 individual parts were categorized according to failure mode, elemental mechanical function, and corrective action employed. A three-dimensional failure-experience cell matrix was developed to implement the organization and analysis of the data. Efforts to quantitatively evaluate corrective action effectiveness were hampered by a lack of quantitative data, but a qualitative evaluation was accomplished. (Modified author abstract)

GRA

N75-10074# Lord Kinematics, Erie, Pa.
ENDURANCE TESTING OF AN LM-726-4 ELASTOMERIC PITCH CHANGE BEARING

David L. Myers Jun. 1974 75 p refs

(Contract DAAJ02-72-C-0091; DA Proj. 1F1-63204-DB-38)

(AD-784140; USAAMRDL-TR-74-35) Avail: NTIS CSCL 01/3

Presented in the report are the results of a 2000-hour endurance test on the LM-726-4 elastomeric pitch change bearing designed for the all-elastomeric rotor in the AH-1G helicopter. The LM-726-4 is an improved version of a previously tested pitch change bearing incorporating several design modifications with the goal of improving fatigue life. Testing was conducted to form a basis for determining the airworthiness of the bearing in terms of expected reliability and inspection and replacement criteria. (Modified author abstract)

GRA

N75-10075# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

INVESTIGATION OF THE EFFECTS OF BLADE STRUCTURAL DESIGN PARAMETERS ON HELICOPTER STALL BOUNDARIES Final Report

R. H. Blackwell and G. L. Commerford May 1974 157 p refs

(Contract DAAJ02-72-C-0105; DA Proj. 1F1-62208-AA-82)

(AD-784594; USAAMRDL-TR-74-25) Avail: NTIS CSCL 01/3

An experimental and analytical study was conducted to determine the effects of blade structural design parameters on the stall-related operating boundaries of helicopter main rotors.

Emphasis was placed on the effects of blade torsional properties on the buildup of vibratory control loads in stall. The analytical methods used in the study were evaluated through correlation with data for two full-scale rotors and data obtained on a two-dimensional airfoil system whose torsional dynamics simulated those of a rotor blade. (Modified author abstract)

GRA

N75-10076# Naval Academy, Annapolis, Md.
OPTIMUM RATE OF CLIMB FOR HIGH PERFORMANCE AIRCRAFT

Ray P. Craig 21 May 1974 33 p refs

(AD-784112; USNA-TSPR-53) Avail: NTIS CSCL 01/2

The general aircraft performance problem is considered from the point of view of the balance of forces on an aircraft. The fundamental performance equation yields by use of calculus of variations a closed form equation for the velocity altitude relationship which represent the optimum time climb path. Application of this equation to an operational jet aircraft, the F-4J, yields an actual solution in close agreement with the generally accepted path. This work is done on the assumption that the thrust of a jet engine can be described by a simple quadratic expression. (Modified author abstract)

GRA

N75-10077# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A STUDY OF THE DAMPING CHARACTERISTICS ON MODELS OF SUPERSONIC AIR LINES AT SUPERSONIC SPEEDS

N. N. Tyunin and M. V. Ushakov 24 Jul. 1974 11 p refs
Transl. into ENGLISH of Tr. Rzhskii Inst. Inzh. Gradzhanskoi Aviatsii (USSR), no. 197, 1971 p 58-65

(FTD Proj. T74-01-12)

(AD-784259; FTD-HT-23-708-74) Avail: NTIS CSCL 20/4

The article presents the results of an experimental study of the damping moment coefficients of the configuration of supersonic airliner models with small wing aspect ratios in a supersonic wind tunnel. A comparison of experimental and calculated data is presented.

GRA

N75-10078# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF THE FORCES IN THE RETRACTOR OF A THREE-DIMENSIONAL LANDING GEAR MECHANISM

I. M. Mitryaev 14 Aug. 1974 17 p ref Transl. into ENGLISH from Tr. Kaz. Aviats. Inst. (USSR), no. 81, 1963 p 35-44

(AF Proj. 1369)

(AD-784257; FTD-HT-23-788-74) Avail: NTIS CSCL 01/3

Three-dimensional mechanisms of the link type have received broad application for aircraft with retractable landing gear along the span. A number of works has been dedicated to the investigation of these types of mechanisms. Questions of the kinematics and the determination of the forces in the retractor are examined in the present paper.

GRA

N75-10079# Army Electronics Command, Fort Monmouth, N.J.
A STUDY OF STABILIZATION TECHNIQUES FOR SMALL, FIXED-WING, REMOTELY PILOTED AIRCRAFT Final Report

A. W. Campagna and R. E. Pribyl Aug. 1974 124 p

(DA Proj. 67372512-K-2101)

(AD-784109; ECOM-4239) Avail: NTIS CSCL 01/3

This report is concerned with the dynamic response of small, fixed wing RPV's to atmospheric disturbances. Several alternative control techniques were modeled and implemented in a hybrid simulation, and an assessment of relative performance was made.

Author (GRA)

N75-10080# Arinc Research Corp., Annapolis, Md.
INTERSERVICE UTILITY HELICOPTER RELIABILITY AND MAINTAINABILITY COMPARATIVE ANALYSIS Final Report.
 Jan. 1972 - Apr. 1974

D. J. Hoffman Jun. 1974 33 p ref
 (Contract DAAJ02-71-D-0001; DA Proj. 1F1-62205-A-119)
 (AD-784177; OB22-02-1-1292; USAAMRDL-TR-74-43) Avail:
 NTIS CSCL 01/3

The comparative reliability and maintainability (R and M) performance of Army, Air Force, and Navy helicopters on an interservice basis was investigated. The report presents a management summary of the approach taken to correlate and analyze the performance data on systems, subsystems, assemblies, and parts used in common by the three services, as well as data on common functional applications of equipments. The results of the investigation are presented, with explanations of the performance differences and similarities. The study encompassed the development and implementation of the procedures for performing an interservice helicopter analysis on a very small selected sample of components from the Army's UH-1H; the Air Force's UH-1F, TH-1F, and UH-1P; and the Navy's UH-1E helicopters. (Modified author abstract) GRA

N75-10081# Bell Helicopter Co., Fort Worth, Tex.
LOW TEMPERATURE TESTING OF AN AH-1G HELICOPTER EQUIPPED WITH ELASTOMERIC FLAPPING AND FEATHERING BEARINGS IN THE MAIN ROTOR Final Report.
 22 Oct. - 17 Nov. 1973

B. P. White Jul. 1974 40 p refs
 (Contract DAAJ02-72-C-0114; DA Proj. 1F1-63205-DB-38)
 (AD-784189; BHC-299-099-672; USAAMRDL-TR-74-54) Avail:
 NTIS CSCL 01/3

Low-temperature testing of an AH-1G helicopter equipped with a main rotor incorporating elastomeric flapping and feathering bearings was conducted in the McKinley Climatic Laboratory at Elgin AFB, Florida. The purpose of the test was to determine the low-temperature service suitability of the elastomeric bearings. (Modified author abstract) GRA

N75-10082# Boeing Vertol Co., Philadelphia, Pa.
TECHNOLOGY DEVELOPMENT REPORT: RESULTS OF STATIC ELECTRICITY DISCHARGE SYSTEM TESTS (ACTIVE AND PASSIVE) HEAVY LIFT HELICOPTER Final Report

John B. Solak and Gregory J. Wilson May 1974 232 p refs
 (Contract DAAJ01-71-C-0840)
 (AD-784130; T301-10194-1; T301-10194-2;
 USAAMRDL-TR-74-22) Avail: NTIS CSCL 01/3

The document presents the findings of a three-phase program consisting of laboratory tests, ground tests, and a full-scale flight test program to evaluate methods for active dissipation of the static electricity buildup on the Heavy Lift Helicopter (HLH). Remote helicopter-borne electric field mills were also evaluated as sensors of the electrical potential between the hovering helicopter and the ground. Flight tests were conducted on a CH-47 helicopter, since the HLH is currently in its development stage. This document also presents the final results of the static electricity drainage tests for the Heavy Lift Helicopter (HLH) Advanced Technology Component (ATC) development program. (Modified author abstract) GRA

N75-10083# Honeywell, Inc., Minneapolis, Minn. Government and Aeronautical Products Div.

YAW AXIS STABILITY AUGMENTATION SYSTEM FLIGHT TEST REPORT Final Report. 1 Jun. 1972 - 30 Nov. 1973
 Harvey Ogren, Donald Sotanski, and LeRoy Genaw Jun. 1974 111 p refs
 (Contract DAAJ02-72-C-0111)
 (AD-784134; USAAMRDL-TR-74-39) Avail: NTIS CSCL 01/3

The report describes the design and flight tests of a hydrofluidic yaw stability augmentation system (SAS) for an OH-58A helicopter. The design objective was to improve stability characteristics in yaw for all flight conditions from hover to

120 kn. The yaw SAS, which initially featured only high-passed yaw rate feedback, was installed in an OH-58A helicopter and flight tested in 1972. Performance at forward flight speeds was satisfactory; but at hover, yaw rates were excessive. The system was then modified to add a straight-through yaw rate feedback term. Flight tests of this configuration were conducted from October-December 1973. Results were satisfactory.

Author (GRA)

N75-10084# Army Land Warfare Lab., Aberdeen Proving Ground, Md.

HELICOPTER DROPSIGHT Final Report

Neal C. Wogsland May 1974 19 p
 (AD-784551; LWL-TR-74-29) Avail: NTIS CSCL 19/5

The Helicopter Dropsight was developed for use when hand dropping unattended ground sensors and other hardware from UH-1D/H helicopters. It consists of a simple cross hair mounted in a ring that projects outside the helicopter on an arm attached to a standard installed in a rear doorway. Sighting consists of aligning the cross hair, a marker on the helicopter skid, and the drop zone. It can be adjusted for various drop conditions, weighs less than 10 pounds, and can be installed within 5 minutes. Dropsights have been evaluated and are being used for training by the US Army Intelligence Center/School at Fort Huachuca, AZ. Author (GRA)

N75-10085# Office of the Director of Defense Research and Engineering, Washington, D.C.

T AND E GUIDELINES FOR AIRCRAFT SYSTEMS

2 Apr. 1974 62 p
 (AD-784549) Avail: NTIS CSCL 01/3

A checklist for aircraft testing and evaluation is presented. Checklist items are used as guidelines for personnel activities during the conceptual phase, validation phase, full-scale engineering development phase, and the substantial production/deployment phase. The specialized aspects of individual subsystems performance tests are explained. Author

N75-10088*# New York Univ., N.Y. Aerospace and Energetics Lab.

FLUID DYNAMIC ASPECTS OF JET NOISE GENERATION Final Report. 1 Oct. 1973 - 30 Sep. 1974

30 Sep. 1974 110 p refs
 (Grant NGR-33-016-177)
 (NASA-CR-140673) Avail: NTIS HC \$5.25 CSCL 20A

The location of the noise sources within jet flows, their relative importance to the overall radiated field, and the mechanisms by which noise generation occurs, are studied by detailed measurements of the level and spectral composition of the radiated sound in the far field. Directional microphones are used to isolate the contribution to the radiated sound of small regions of the flow, and for cross-correlation between the radiated acoustic field and either the velocity fluctuations or the pressure fluctuations in the source field. Acquired data demonstrate the supersonic convection of the acoustic field and the resulting limited upstream influence of the signal source, as well as a possible increase of signal strength as it propagates toward the centerline of the flow. Author

N75-10091*# Boeing Commercial Airplane Co., Seattle, Wash.
SCALE MODEL TESTING OF THE JET NOISE CHARACTERISTICS OF THE JT8D REFIN ENGINE NOZZLE SYSTEM

D. H. Reed Mar. 1974 164 p
 (Contract NAS3-17842)
 (NASA-CR-134618; D6-41529) Avail: NTIS HC \$6.25 CSCL 20A

The results are presented of static scale model acoustic tests of the nozzle system for the JT8D-9 baseline engine and candidate nozzle systems for JT8D-109, JT8D-115, and JT8D-117 refan engines. The objective of these tests was to determine the jet noise benefit of the three refan engine cycles relative to the baseline JT8D-9, and to provide acoustic information toward selection of the optimum primary-secondary area match and centerbody contour for the refan engine cycles.

One of the nozzle configurations was tested with and without simulated turbine exit swirl to determine what effect, if any, swirl has on jet noise. The JT8D-109 cycle was found to afford approximately 9 db (OASPL) jet noise reduction relative to the JT8D-9 when compared on an equal static thrust basis. The JT8D-115 and JT8D-117 afford an 8 db and 6 db reduction, respectively, relative to the JT8D-9, at equal static thrust. Turbine exit swirl was found to have no significant effect on the jet noise of the JT8D-109 nozzle system. Author

N75-10093* Stanford Research Inst., Menlo Park, Calif.
RELIABILITY OF LABORATORY TESTS OF VSTOL AND OTHER LONG DURATION NOISES Final Report
 K. D. Kryter, D. J. Peeler, M. E. Dobbs, and J. S. Lukas Washington NASA Nov. 1974 44 p refs
 (Contract NAS1-11602)
 (NASA-CR-2471) Avail: NTIS HC \$3.75 CSCL 20A

Paired-comparison and magnitude estimations of the subjective noisiness or unacceptability of noise from fixed wing jet aircraft and simulated noise of VSTOL aircraft were obtained from groups of subjects given different instructions. These results suggest that VSTOL noises can be evaluated in terms of their noisiness or unwantedness to people with reasonable accuracy by units of the physical measures designated as PNdbM, with or without tone corrections, and dBD sub 2. Also, that consideration should be given to the use of D sub 2 as an overall frequency weighting function for sound level meters instead of the presently available A weighting. Two new units of noise measurement, PLdB and dB(E), used for predicting subjective noisiness, were found to be less accurate than PNdbM or dBD sub 2 in this regard. Author

N75-10094* General Electric Co., Schenectady, N.Y.
ISOLATED ROTOR NOISE DUE TO INLET DISTORTION OR TURBULENCE Final Report
 Ramani Mani Washington NASA Oct. 1974 46 p refs
 (Contract NAS3-17853)
 (NASA-CR-2479) Avail: NTIS HC \$3.75 CSCL 10C

Theoretical formulation, analysis, and results are presented that are necessary to analyze quadrupole noise generated from a loaded, subsonic rotor because of its interaction with an inflow distortion or inlet turbulence. The ratio of quadrupole to dipole noise is largely a function of the axial Mach number, wheel tip Mach number, rotor solidity, and total pressure ratio across the rotor. It is relatively independent of the specific form of the inflow distortion or inlet turbulence. Comparisons with experimental data only succeed in predicting gross levels at a given speed and fail to predict the variation of noise at fixed speed with flow and pressure ratio. Likely sources of this discrepancy are discussed. Author

N75-10095* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
REAL-TIME SIMULATION OF THE TF30-P-3 TURBOFAN ENGINE USING A HYBRID COMPUTER
 John R. Szuch and William M. Bruton Washington Oct. 1974 104 p refs
 (NASA-TM-X-3106; E-7904) Avail: NTIS HC \$5.25 CSCL 21E

A real-time, hybrid-computer simulation of the TF30-P-3 turbofan engine was developed. The simulation was primarily analog in nature but used the digital portion of the hybrid computer to perform bivariate function generation associated with the performance of the engine's rotating components. FORTRAN listings and analog patching diagrams are provided. The hybrid simulation was controlled by a digital computer programmed to simulate the engine's standard hydromechanical control. Both steady-state and dynamic data obtained from the digitally controlled engine simulation are presented. Hybrid simulation data are compared with data obtained from a digital simulation provided by the engine manufacturer. The comparisons indicate that the real-time hybrid simulation adequately matches the baseline digital simulation. Author

N75-10097# Boeing Vertol Co., Philadelphia, Pa.
HLH/ATC ENGINE SHAFT SUPPORT BEARING DEVELOPMENT PROGRAM Final Test Results and Technology Development Reports
 J. W. Lenski, Jr. May 1974 122 p Sponsored in part by Army Aviation Systems Command
 (Contract DAAJ01-71-C-0840)
 (AD-784593; T301-10237-1; USAAMRDL-TR-74-16) Avail: NTIS CSCL 01/3

Drive shafting which transmits power between combining transmission and engines is supported by ball bearings to structure. Because of the difficulty of providing fluid lubrication to these bearings, they have always been lubricated with grease. Present experience with the CH-46 and CH-47 helicopters has shown that these bearings will perform adequately with grease lubrication at DN operating speeds of 450,000. The HLH drive system will use a similar bearing configuration to support both the synchronizing shafts and the engine shafts. Because of the increased speed requirements for a grease-lubricated ball bearing, a test program was conducted to determine the operating characteristics, design modifications and maximum regreasing interval for a ball bearing operating at the maximum loads and speed of the HLH engine and synchronizing shaft support bearing. (Modified author abstract) GRA

N75-10103# European Space Research Organization, Paris (France).

OPTIMUM TRANSIENT RESPONSE CHARACTERISTIC OF A VTOL AIRCRAFT WITH DIRECT SIDE FORCE CONTROL
 Ruthard Koehler, K. Wilhelm et al May 1974 83 p refs
 Transl. into ENGLISH of Ueber regelungstech. Eigenschaften eines VTOL-Flugzeugs mit direkter Seitenkraftsteuerung. DLR-FB-73-72, DFVLR, 22 May 1973
 (DLR-FB-73-72; ESRO-TT-79) Avail: NTIS HC \$4.75; DFVLR, Porz, West Ger. 18.50 DM

VTOL aircraft with low roll control power are criticized by pilots as sluggish. After attaining the direction of approach the correlation of lateral deviations and side wind forces cannot be performed satisfactorily. Jet deflections generating side forces improve control characteristics. The optimization of some controllers and their applicability are discussed. Author (ESRO)

N75-10106* Wyle Labs., Inc., Hampton, Va. Scientific Services and Systems Group.

NASA-LANGLEY HELICOPTER TOWER INSTRUMENTATION SYSTEMS
 S. W. Stoffel Oct. 1974 118 p
 (Contract NAS1-12841)
 (NASA-CR-132522; Rept-50601) Avail: NTIS HC \$5.25 CSCL 14B

Background information is presented for the helicopter rotor test facility, in preface to a more detailed discussion of major subsystems equipment, including error considerations, frequency response, and display instrumentation. A.A.D.

N75-10107# National Research Council of Canada, Ottawa (Ontario); Gas Dynamics Lab.

EXPERIENCE WITH THE NRC 10 FEET BY 20 FEET V/STOL PROPULSION TUNNEL: SOME PRACTICAL ASPECTS OF V/STOL ENGINE MODEL TESTING
 R. A. Tyler and R. G. Williamson Jul. 1973 32 p refs
 Reprinted
 (DME/NAE-1973(2)) Avail: NTIS HC \$3.75

Experience in the operation and use of the NRC 10 ft. x 20 ft V/STOL propulsion tunnel is reviewed. This research facility, designed specifically for the investigation of problems relating to V/STOL engine systems, was first operated in December 1962. Representative experimental programs carried out in the tunnel since that time are used to illustrate general problem areas associated with the testing of highpowered models. Author

N75-10112# Illinois Univ., Savoy. Aviation Research Lab.
**EFFECTS OF GROUND-BASED AIRCRAFT SIMULATOR
 MOTION CONDITIONS UPON PREDICTION OF PILOT
 PROFICIENCY, PART 1** Scientific Interim Report

Jefferson M. Koonce Apr. 1974 106 p refs
 (Contract F44620-70-C-0105; AF Proj. 9778)
 (AD-783256; ARL-74-5/AFOSR-74-3-Pt-1;
 AFOSR-74-1292TR-Pt-1) Avail: NTIS CSCL 05/9

Three groups of thirty pilots with multi-engine and instrument ratings performed a simulated flight mission in a General Aviation Trainer on each of two days. The experimental conditions for the groups differed in terms of GAT-2 motion: no motion; sustained linear, scaled-down analog motion; and washout motion. Each group of pilots then flew the same mission in a light twin-engine aircraft representative of the class of aircraft simulated by the GAT-2. The results indicated that the proficiency of aircraft pilots can be predicted to a high degree from ground-based simulator performance measures. (Modified author abstract)

GRA

N75-10290# Sandia Labs., Albuquerque, N.Mex.
**AIRCRAFT-VELOCITY MEASUREMENT THROUGH RADAR-
 ALTIMETER ECHO WITH NONCOHERENT DETECTION**

C. S. Williams Mar. 1974 48 p refs
 (Contract AT(29-1)-789)
 (SLA-74-112) Avail: NTIS HC \$3.75

The accuracy of a method of measuring aircraft velocity through the use of the echo received by a radar altimeter is discussed, with attention to the effect of square-law detection. A formula was derived which sets a low enough upper limit for the calculation of maximum allowable integration time 2T. The effect of pulse was also considered, where both the leading antenna and the trailing antenna transmit and receive the same wave. The device is described which transmits downward and receives upward the echo from the terrain.

Author

N75-10292# European Space Research Organization, Paris (France).

**REAL-TIME MEASURING PROCEDURE AND MEASURING
 EQUIPMENT FOR RECORDING THE RADIATION PAT-
 TERNS OF AIRCRAFT ANTENNAS IN FLIGHT**

Ulrich Hinzpeter, H. Mattes et al Jun. 1974 58 p refs Transl. into ENGLISH of Real-Time-Messverfahren u. -Messanlage zur Flugvermessung der Strahlungsdiagramme von Flugzeugbordan-tennen. DLR-FB-73-97, DFVLR, 6 Aug. 1973
 (ESRO-TT-74; DLR-FB-73-97) Avail: NTIS HC \$4.25; DFVLR, Porz, West Ger. 24.90 DM

A new measuring procedure to obtain immediate recordings of the radiation patterns of aircraft antennas while under test in actual flying conditions is described. This real time measuring procedure replaces older methods that have become uneconomic because of the high demands made on personnel, time, and equipment. The new procedure has already proved itself in the course of several antenna measurements. Previously used measuring methods are briefly described and discussed.

Author (ESRO)

N75-10327# Naval Research Lab., Washington, D.C.
A PROTOTYPE FOUR-HORN CLUSTER IFF ANTENNA Final Report

Edward C. Bean Jul. 1974 23 p refs
 (AD-784395; NRL-MR-2836) Avail: NTIS CSCL 09/5

The experimental design of a prototype four-horn cluster IFF antenna is described. The antenna was evaluated for voltage standing wave ratio (VSWR), model antenna range patterns, and in-flight horizontal and banked aircraft radiation patterns. The data is presented to show that each antenna horn demonstrates isotropic gain within plus or minus 45 degrees of its azimuth pointing direction and a front to back ratio gain of about 20 db. The prototype antenna will provide an aircraft with improved and controlled coverage for reception of IFF signals and will limit the volume of space to which its replies are radiated.

Author (GRA)

N75-10332# Office of the Director of Defense Research and Engineering, Washington, D.C.

T AND E GUIDELINES FOR AIRBORNE ECM SYSTEMS

2 Apr. 1974 32 p
 (AD-784574) Avail: NTIS CSCL 17/4

The checklist items presented are specifically applicable to airborne ECM testing and evaluation. The following classes of airborne ECM equipment were considered. Active jammers carried on dedicated ECM aircraft. Airborne passive reconnaissance and warning systems. Active jammer pods carried by tactical aircraft. Active jammers carried internally on strategic aircraft. Deceptive repeater jammers carried both internally and in pods on tactical or strategic aircraft. The checklist items are organized into time phases of the acquisition process, and might cover the (1) evaluation of work that occurred in the previous phase, (2) conduct of tests planned in the previous phase and executed in the subject phase, and (3) plans and other preparatory actions for test schedules to be conducted in a subsequent phase. GRA

N75-10358# Flow Research, Inc., Kent, Wash.
**A VISCOUS/POTENTIAL FLOW INTERACTION ANALYSIS
 METHOD FOR MULTI-ELEMENT INFINITE SWEEP WINGS,
 VOLUME 1**

F. A. Dvorak and F. A. Woodward Washington NASA Nov. 1974 91 p refs
 (Contract NAS2-7048)

(NASA-CR-2476) Avail: NTIS HC \$4.75 CSCL 20D

An analysis method and computer program have been developed for the calculation of the viscosity dependent aerodynamic characteristics of multi-element infinite swept wings in incompressible flow. The wing configuration consisting at the most of a slat, a main element and double slotted flap is represented in the method by a large number of panels. The inviscid pressure distribution about a given configuration in the normal chord direction is determined using a two dimensional potential flow program employing a vortex lattice technique. The boundary layer development over each individual element of the high lift configuration is determined using either integral or finite difference boundary layer techniques. A source distribution is then determined as a function of the calculated boundary layer displacement thickness and pressure distributions. This source distribution is included in the second calculation of the potential flow about the configuration. Once the solution has converged, (usually after 2-5 iterations between the potential flow and boundary layer calculations) lift, drag, and pitching moments can be determined as functions of Reynolds number. Author

N75-10359# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

**A COMPUTING METHOD FOR SOUND PROPAGATION
 THROUGH A NONUNIFORM JET STREAM**

Sharon L. Padula and Chen-Huei Liu Dec. 1974 19 p refs
 (NASA-TM-X-71941) Avail: NTIS HC \$3.25 CSCL 20D

Understanding the principles of jet noise propagation is an essential ingredient of systematic noise reduction research. High speed computer methods offer a unique potential for dealing with complex real life physical systems whereas analytical solutions are restricted to sophisticated idealized models. The classical formulation of sound propagation through a jet flow was found to be inadequate for computer solutions and a more suitable approach was needed. Previous investigations selected the phase and amplitude of the acoustic pressure as dependent variables requiring the solution of a system of nonlinear algebraic equations. The nonlinearities complicated both the analysis and the computation. A reformulation of the convective wave equation in terms of a new set of dependent variables is developed with a special emphasis on its suitability for numerical solutions on fast computers. The technique is very attractive because the resulting equations are linear in nonwaving variables. The computer solution to such a linear system of algebraic equations may be obtained by well-defined and direct means which are conservative of computer time and storage space. Typical examples are illustrated and computational results are compared with available numerical and experimental data. Author

N75-10370 European Space Research Organization, Paris (France).

ANALOG SIMULATION OF THE SMALL PERTURBATION EQUATION APPLIED TO TRANSONIC FLOWS c02
Georges Gaubert *In its* Aerospace Res. (ESRO-TT-40) Apr. 1974 p 67-93 refs Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel No. 1973-5, ONERA 1973, p 289-299

The small perturbation equation is simulated by a resistive network in which resistor units whose resistance is variable with the applied voltage represent the nonlinear term. These units are made of elements (diodes and resistors) associated with integrated operational amplifiers. A visualization system displaying the profile, local slopes, velocity, and perturbation potential distributions, makes it possible to know without delay the evolution tendency of the various parameters. The method, validated, was applied to flows along walls and around cascades. Author (ESRO)

N75-10371 European Space Research Organization, Paris (France).

DETERMINATION OF THE DYNAMIC CHARACTERISTICS OF A STRUCTURE FROM A VIBRATION TEST PERFORMED WITH ONLY ONE EXCITATION POINT
Rolland Dat *In its* Aerospace Res. (ESRO-TT-40) Apr. 1974 p 94-109 refs Transl. into ENGLISH from La Rech. Aerospatiale, Bull. Bimestriel No. 1973-5, ONERA 1973, p 301-306

A method is described which permits the determination of the matrix of transfer functions from a vibration test performed with only one excitation point. It is based on the theory of linear discrete systems and utilizes a least squares procedure to obtain the rational fraction which fits best with the measured transfer functions. The coefficients defining the complete transfer matrix are obtained after separation into partial fractions. The validity of the method is illustrated by examples of application to aircraft structures. Author (ESRO)

N75-10487# Advisory Group for Aerospace Research and Development, Paris (France).

LOW CYCLE HIGH TEMPERATURE FATIGUE
Aug. 1974 149 p refs In FRENCH and ENGLISH Presented at the 38th meeting of the Struct. and Mater. Panel, Washington, D. C., 21-26 Apr. 1974 (AGARD-CP-155) Avail: NTIS HC \$5.75

The operating conditions of aircraft are discussed in terms of propulsive efficiency, especially insofar as fatigue and creep phenomena affect the performance of engines operating at high and variable temperatures, and under cyclic stresses. Low cycle high temperature fatigue studies were conducted to obtain data related to these questions.

N75-10490 Newcastle-upon-Tyne Univ. (England). Dept. of Mechanical Engineering.

PRECISION IN LCHTF TESTING
E. M. Smith *In* AGARD Low Cycle High Temp. Fatigue Aug. 1974 19 p refs

Fast and accurate temperature control in low cycle high temperature fatigue (LCHTF) testing depends on an accurate sensitivity to changes in stress and temperature levels, oxidation, direction, and rates of loading. Extremities of the possible test spectrum are described in terms of constitutive testing and component testing. An evaluation of thermal and stress fields within the specimen geometry, selection of appropriate heating and cooling methods, and assessment of precision of measurement under thermal and mechanical transients were all involved in the constitutive behavior testing. Coupon testing, utilizing precisely controlled thermal shocks, was used to measure component response to LCHTF conditions. Author

N75-10491 National Gas Turbine Establishment, Pyestock (England). Materials Science Dept.

THE EFFECT OF CYCLE PARAMETERS ON HIGH TEMPERATURE LOW CYCLE FATIGUE

G. F. Harrison and M. G. Cockcroft *In* AGARD Low Cycle High Temp. Fatigue Aug. 1974 15 p refs

The types of information required by engine designers in the area of high temperature low cycle fatigue engine parameters are summarized, particularly concerning temperature effects, frequency and hold-time effects, and the effects of strain cycling and stress cycling. The choice of testing method is dependent on the type of analysis employed when making use of the data and the various possible approaches are compared. It is suggested that in high temperature situations there is often advantage in regarding fatigue as a creep-dominated process. Some gaps in the present state of knowledge are indicated. Author

N75-10493 Connecticut Univ., Storrs. Dept. of Metallurgy.
LIFETIME PREDICTION METHODS FOR ELEVATED TEMPERATURE FATIGUE

A. J. McEvily and S. R. Crosby *In* AGARD Low Cycle High Temp. Fatigue Aug. 1974 18 p refs

Methods for lifetime prediction at elevated temperatures can be categorized as either: (1) parametric; (2) damage summation; (3) strainrange partitioning; or (4) frequency modification. The capabilities and limitations of these various approaches are discussed, and the problem of extrapolation beyond laboratory experience is considered. Author

N75-10494 Pratt and Whitney Aircraft, Middletown, Conn. Materials Engineering and Research Lab.

DESIGN PROCEDURES FOR ELEVATED TEMPERATURE LOW-CYCLE FATIGUE
C. H. Wells *In* AGARD Low Cycle High Temp. Fatigue Aug. 1974 17 p refs

The state of the art review of component design against low-cycle fatigue failure at elevated temperature, covers the areas of failure criteria, nondestructive inspection, constitutive behavior, prediction of crack initiation and propagation lifetime, applicability of linear elastic fracture mechanics, and structural verification. Special problems posed by gas turbine applications are discussed, along with major gaps in understanding and techniques. Chief among these are the nondestructive characterization of surfaces and internal flaws, definition of the limitations of fracture mechanics in the regime of intergranular cracking, the prediction of mean stress and cyclic creep, and the experimental verification of analytical procedures at high temperature. Author

N75-10755# Loughborough Univ. of Technology (England). Dept. of Transport Technology.

A SURVEY OF AIRCRAFT NOISE ANNOYANCE IN AN AREA OF INVARIANT NOISE TO ELIMINATE THE EFFECTS ON ANNOYANCE OF VARYING NOISE EXPOSURE

R. M. Edwards and J. B. Ollerhead May 1974 71 p refs (Contract SN/1170/012) Avail: NTIS HC \$4.25

The large variability in the measurement of human response to aircraft noise is described, and the philosophy behind a social survey designed to eliminate some causes of this variability by considering a small geographical area of constant noise is outlined. Results from the survey show that, so long as effects of aircraft noise are measured by the Guttman Annoyance Scale, there is little point in trying to find an improved noise measurement index. ESRO

N75-10780 Smiths Industries Ltd., Bishops Cleeve (England). Aviation Div.

HEAD-UP DISPLAY OPTICS
R. A. Chorley *In* AGARD Opto-Electronics Sep. 1974 18 p

The factors which influence the definition of the optical system for a Head-Up Display are defined. The conflicting requirements for wide fields of view and compact, easily installed hardware are discussed (with relation to both refractive and reflective optical systems) together with various aspects of optical performance which influence the overall display system performance. The primary reason for installing a HUD system in a military

aircraft is the improved weapon-aiming capability it can provide. From this point of view the HUD can be looked upon as a sophisticated descendant of the various forms of optical gunsight which have been in service for a quarter of a century or more. Thus the most basic requirement for a military HUD system is that it should provide the information needed for weapon aiming, and this means that it must provide an aiming symbology display, focussed nominally at infinity, so that the pilot can correlate and utilize the display and the outside world information simultaneously. Author

N75-10786* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A TECHNIQUE FOR DISPLAYING FLIGHT INFORMATION IN THE FIELD OF VIEW OF BINOCULARS FOR USE BY THE PILOTS OF RADIO CONTROLLED MODELS

Harry V. Fuller Sep. 1974 17 p
(NASA-TM-X-72015) Avail: NTIS HC \$3.25 CSCL 20F

A display system was developed to provide flight information to the ground based pilots of radio controlled models used in flight research programs. The display system utilizes data received by telemetry from the model, and presents the information numerically in the field of view of the binoculars used by the pilots. Author

N75-10903# Committee on Science and Astronautics (U. S. House).

GENERAL AVIATION PROGRAMS

Washington GPO 1974 35 p Rept. prepared by Subcomm. on Aeron. and Space Technol. of Comm. on Sci. and Astronaut., 93d Congr., 2d Sess., 16 Oct. 1974
(GPO-41-153) Avail: Subcomm. on Aeron. and Space Technol.

The hearings concerning general aviation are reported. Conclusions and recommendations include: (1) general aviation makes a significant contribution to the air transportation system. In addition to offering service between major cities, it provides the only air transportation to many locations not served by scheduled air carriers. General aviation aircraft are used for a broad range of purposes, e.g., from business flying to direct commercial and agricultural applications; (2) general aviation makes a strong input to our economy by generating employment and revenue; (3) a principal requirement of general aviation is the development of technology to meet stringent Federal regulation on noise abatement and exhaust emissions; (4) it is essential that NASA maintain close communication with the general aviation community. F.O.S.

N75-10910 Society of Flight Test Engineers, Lancaster, Calif.

ADVANCEMENTS IN FLIGHT TEST ENGINEERING

1974 403 p refs Presented at the 5th Ann. Symp. of the Soc. of Flight Test Eng., Anaheim, Calif., 7-9 Aug. 1974
(LC-74-136-52) Copyright. Avail: Issuing Activity CSCL 01B

The proceedings of a symposium on advancements in flight test engineering are presented. The subjects discussed include the following: (1) developing short takeoff and landing operational criteria, (2) avionics system testing, (3) test data acquisition, processing, and analysis, and (4) environmental testing. Specific examples of aircraft on which tests were conducted are provided. Specialized systems for conducting tests and recording flight test data are explained. Emphasis is placed on the use of simulators for research and development as well as operational evaluation of weapon systems.

N75-10911 National Aviation Facilities Experimental Center, Atlantic City, N.J.

DEVELOPING STOL OPERATIONAL CRITERIA

Roman M. Spangler In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 62 p

A DeHavilland DHC-6, Series 100 Twin Otter was flown by a representative group of pilots on various steep-gradient

approaches onto a ground-level STOL runway. Approximately 800 approaches and landings were accomplished to provide a data base to approve a first-generation STOL operation. Areas investigated included: (1) aircraft handling and response on steep-gradient approaches with various approach electronic beam sensitivities, (2) location of the ground point of intercept; (3) co-located versus split localizer/glideslope signal source; (4) obstacle clearance requirements; (5) field length requirements; and (6) influence of command-steering on aircraft/pilot performance. Author

N75-10912* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

NASA FLIGHT RESEARCH CENTER SCALE F-15 REMOTELY PILOTED RESEARCH VEHICLE PROGRAM

Garrison P. Layton In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 14 p refs

CSCL 01B

A remotely piloted research vehicle (RPRV) program was conducted with a 3/8-scale model of an F-15 airplane to determine the usefulness of the RPRV testing technique in high risk flight testing such as spin testing. The results of the first flights of the program are presented. The program has shown that the RPRV technique, including the use of a digital control system, is a viable method for obtaining flight research data. Also presented are some negative aspects that have been learned about the RPRV technique in terms of model size, command frequency, and launch technique. Author

N75-10914 Naval Air Development Center, Warminster, Pa.

THE R AND D SIMULATOR: A NEW T AND E TOOL

Robert L. Fortenbaugh In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 18p

A NASA-Ames R and D (research and development) simulator was utilized through the development phase of the F-14A program and on a continuing basis into the T and E (test and evaluation) phase. This utilization has concentrated on development and evaluation of the APC (Approach Power Compensator), AFCS (Automatic Flight Control System), and ACLS (Automatic Carrier Landing System). The importance and success in use of this simulator during the T and E phase is discussed with respect to accuracy of duplicating and predicting flight test results, pilots acceptance of the simulator as a valid representation of the real airplane, and cost effectiveness for reducing flight time while increasing flexibility. The success of this program has led to the adoption of a similar approach for APC, AFCS, and ACLS development for the S-3A airplane and for reevaluation of the A-7E ACLS capability. Author

N75-10915 Naval Air Test Center, Patuxent River, Md. Flying Qualities and Performance Branch.

FLIGHT FIDELITY TESTING OF US NAVY OPERATIONAL FLIGHT TRAINERS

R. Thomas Galloway In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 12 p

The utilization of flight test results and techniques to improve Operational Flight Trainers (OFT) is discussed. An OFT is a simulator designed to represent a specific aircraft in the service inventory. A typical device consists of a cockpit or set of cockpits having the same interior appearance as the real aircraft including functional instruments, an instructor station for monitoring and controlling various flight parameters, a digital computer system for solving the equations of motion and systems routines, and a hydraulic system for the control stick and motion base servo-mechanisms. Actions taken to improve the performance of specific OFT devices are described. Author

N75-10917 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

INTEGRATED AVIONICS: CONTROLS AND DISPLAYS FOR HELICOPTER IFR OPERATION

F. J. Winter, Jr. In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 12 p refs

A flight research effort has been established to investigate all aspects of helicopter instrument flight rule (IFR) operations ranging from lift-off, transition to cruise, approach, hover, and landing. The basic purpose is to evaluate recent developments in rotary wing instrument flight capability. These developments center around vehicle controllability through both control/display and stability augmentation systems. The configuration to be first evaluated was designed from the results documented by actual pilot performance during typical rotary wing IFR maneuvers. The maneuver profiles were designed and flown to record pilot activity and aircraft attitude. Several subject pilots flew the designed profiles to establish in what areas improvements were required. Each pilot's performance was then computerized to create a mean value of pilot ability to perform prescribed tasks. The analysis of the data gathered determined in what areas pilot performance could most likely be improved through refined helicopter controls and displays. Author

N75-10918 McDonnell-Douglas Corp., Edwards AFB, Calif.
MODE

C. E. Chisolm *In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 19 p*

The F-15 Weapon Delivery Systems, its design concepts and the AIM-7F Sparrow Missile are reported. Flight test objectives and test plan formulation for the evaluation and qualification test phases of the AIM-7F delivery modes are discussed. Intermediate objectives, and how they were achieved utilizing the instrumented captive missile, are established. Primary emphasis, oriented towards conduct of the evaluation test phase include airborne test profiles utilized in conjunction with the captive missile, and the extensive amount of ground based facilities and airborne equipment necessary for such testing. The requirements of the qualification phase are outlined with the development of a typical launch profile. Problems encountered, both technical and support equipment related, are reviewed. Author

N75-10919 Lockheed-Georgia Co., Marietta.
FLIGHT DEMONSTRATION OF THE FEASIBILITY OF A SCANNING BEAM MICROWAVE LANDING SYSTEM

David W. Faris *In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 16 p*

The flight test program to demonstrate the feasibility of a Scanning Beam Microwave Landing System is reported. The reasons for the new landing system, the requirements, the technical concepts, and descriptions of the feasibility hardware are discussed. The preliminary results and conclusions of the flight test program are presented. Tests of the feasibility configurations were conducted in a mobile laboratory for the ground static tests and in a C-118 aircraft for the flight tests. Author

N75-10920 Sperry Phoenix Co., Ariz. Flight Systems.
AUTOMATED AVIONICS SYSTEM CHECKOUT AND MONITORING IN A FLIGHT TEST ENVIRONMENT

B. T. Devlin, D. C. Mossman, and H. R. Urling *In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 16 p refs*

The use of a general purpose digital computer as the central element of an automatic flight guidance and control system to enhance flight test avionics checkout and maintenance is discussed. In addition to its guidance control function, the computer (1) acquires and stores signal and logic data from sensors, and (2) monitors received signals by means of comparison tests, validity checks, or application of reasonableness criteria. Since it has stored this data in memory, it is in a unique position to capitalize on data availability to perform a comprehensive test function by a small addition to the airborne program. In recent applications, including a flight test program in a current design wide-bodied commercial transport, central integrated test and automated maintenance management functions were implemented within the airborne flight guidance and control computer to exercise all equipment during preflight test, fault isolate and report failures in flight with alphanumeric messages, and store maintenance data. Author

N75-10921 Grumman Aerospace Corp., Bethpage, N.Y. Systems Flight Test Section.

AIRBORNE TESTING OF ADVANCED MULTISENSOR AIRCRAFT

Leon Chabot, Norbert Wengler, and Alex Mallow *In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 34 p*

The characteristics of electro-optical sensors used on attack aircraft are discussed. The typical sensors include the following: (1) forward looking infrared (FLIR) devices, (2) low light level television (LLTV) units, and (3) laser transmitters and receivers. Typical flight test objectives for these devices include measurement of resolution and sensitivity of the FLIR and LLTV, and measurement of range and range accuracy using the laser transceiver. The flight testing involves the use of special preliminary ground tests, complex instrumentation and data processing, special targetry, and appropriate flight techniques. A discussion of the relationship of the electro-optics to the overall system, as well as descriptions of the special electro-optical sensors is provided. Author

N75-10922 Computing Devices of Canada, Ltd., Ottawa (Ontario).
JET ENGINE THRUST MEASURING SYSTEM: AN ADVANCEMENT IN FLIGHT TEST ENGINEERING

J. A. Gravelle *In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 12 p ref*

The characteristics of a thrust measuring system based on engine gas pressure and air data computer measurements only are discussed. The system computes a reference gross thrust which is compared with the engine gross thrust. Thrust parameters are displayed on a cockpit instrument. Diagrams of the system are provided and flight test results for specific installations are reported. Author

N75-10924 Naval Air Test Center, Patuxent River, Md.
HIGH SINK-RATE LANDING TESTING OF NAVY AIRCRAFT

George E. Clarke *In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 9 p*

A procedure for measuring the landing sink rate of military aircraft landing on aircraft carriers is described. The systems used are based on the following: (1) two systems use camera film to generate height-time plots which are analyzed for sink rate and sink acceleration data, (2) a downward looking Doppler radar mounted on the aircraft to generate quick-look data, and (3) a system which depends on timing the passage of two aircraft-mounted trihedral mirrors through a fan of light to measure the sink rate. The accuracies obtainable with the various systems are reported. A diagram of a typical test installation is provided. Author

N75-10925 Saab-Scania, Linköping (Sweden).
A SAAB-SCANIA DEVELOPED METHOD FOR OBTAINING STABILITY DERIVATIVES FROM FLIGHT TESTS

Goesta Niss *In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 12 p*

A system for obtaining precise data on aircraft stability and control during flight tests is discussed. A diagram of the system and its components is provided. The techniques for correcting the data to obtain the desired degree of accuracy are analyzed. To prove the validity of the determination, a digital simulation in six degrees of freedom is used. In this simulation the directly measured control surface pulse is combined with trim values and derivatives from flight test to obtain a time history. The time history is then compared with the one directly measured in flight. A typical example of the analysis of an automatic pilot function is provided to show the steps involved in the procedure. Author

N75-10926 Rockwell International Corp., Los Angeles, Calif.
Test and Evaluation Dept.

APPLICATION OF THE FAST FOURIER TRANSFORM TO GROUND VIBRATION TESTING, AND FLIGHT FLUTTER TESTING

Alexander MacKenzie *In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 15 p refs*

Efforts to extend the application of the Fast Fourier Transform, into on-line analysis of Ground Vibration Testing and Flight Flutter Testing are reported. The identification of modal frequencies and damping from both steady and swept sinusoidal excitation is discussed, the capabilities and limitations of the method, and the requirements for structuring both the test method and data acquisition, to suit the technique. The technique is used during ground vibration testing in conjunction with steady sinusoidal excitation: (1) to analyze a large number of accelerometers on line; (2) check orthogonality, to correctly obtain modal purity; and finally to plot and tabulate the resulting mode shapes. In flight flutter testing the ability to analyze modal frequencies and damping from fairly rapid sweeps, with greater accuracy is provided and is intended virtually to eliminate the laborious dwells and decays which can consume so much flight time. Author

N75-10928 McDonnell-Douglas Corp., Long Beach, Calif.
EFFECTIVE DATA MONITORING DURING AIRPLANE FLYOVER NOISE TESTS

Ernest M. Lowder /In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 6 p

The parameters to be considered when conducting flyover tests to measure aircraft noise are discussed. The basic areas considered are: (1) the airplane/engine configuration, (2) airplane/engine performance, (3) flight procedures, (4) weather, (5) terrain, and (6) microphone installation. Emphasis is placed on noise recording validity monitoring and on-site records and measured-data displays. It is stated that adjustments to the planned data sample should be made on the basis of preliminary normalized data. Comprehensive data monitoring requires automated data normalization involving a near-real time flyover noise evaluation system. Author

N75-10929 Transportation Systems Center, Cambridge, Mass.
MONITORING THE MOVEMENT OF WAKE VORTICES AT KENNEDY AND STAPLETON AIRPORTS

James N. Hallock /In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 6 p refs

The characteristics of turbulent wakes developed by aircraft movement and the procedures for analyzing the extent and severity of aircraft wakes, especially in the terminal area, are discussed. The test equipment and data recording devices are described. The approaches to controlling aircraft wakes and reporting the existence of dangerous wake conditions are examined. Author

N75-10930* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

HOT-WIRE ANEMOMETRY FOR IN-FLIGHT MEASUREMENT OF AIRCRAFT WAKE VORTICES

Robert A. Jacobsen /In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 12 p refs

CSCL 01B

Investigations were conducted to determine the characteristics of aircraft wake vortices using hot-wire anemometry. The design features of the measuring technique and the operational experience with it are described. The difficulties involved in obtaining flight test measurements of wake vortices are examined. Three techniques for in-flight measurement of aircraft wake turbulence are explained. Flight test results obtained under specific conditions are presented. Author

N75-10931* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

RESULTS OF FULL-SCALE VORTEX ATTENUATION FLIGHT EXPERIMENTS

Earl C. Hastings, Jr. and Robert A. Champine /In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 21 p refs

Flight tests have been conducted to evaluate the effectiveness of a wing-tip vortex attenuating device, referred to herein as a spline. Vortex penetrations were made with a PA-28 behind a C-54 aircraft with and without wing-tip splines attached and the resultant rolling acceleration was measured and related to

the roll acceleration capability of the PA-28. Tests were conducted over a range of separation distances from about 5 nautical miles to less than 1 n. mi. Preliminary results indicate that, with the splines installed, there was a significant reduction in the vortex-induced roll acceleration experienced by the PA-28 probe aircraft, and the distance at which the PA-28 roll control became ineffective was reduced from 2.5 n. mi. to less than 1 n. mi. Although splines significantly reduced the C-54 rate of climb, the rates available with four engines were acceptable for this test program. Splines did not introduce any noticeable change in the handling qualities of the C-54. Author

N75-10932 Army Aviation Engineering Flight Activity, Edwards AFB, Calif.

US ARMY HELICOPTER ICING TESTS

Warren E. Griffith, II and Marvin L. Hanks /In Soc. of Flight Test Engr. Advan. in Flight Test Eng. 1974 15 p refs

Limited testing of Army helicopters has been conducted in both artificial and natural icing environments. To provide for artificial icing tests, a helicopter icing spray system was developed which has the capability of providing a closely controlled in-flight artificial icing environment. Natural icing tests were conducted to verify that artificial icing characteristics are representative of natural icing characteristics. The test technique utilized was a build-up program in accretion, static temperature, and accretion rate. Of the helicopters tested (UH-1H, AH-1G, AH-1Q, and CH-47C), general problem areas have been identified. Engine ice ingestion, rotor blade impact damage, degraded autorotational capability, high vibration levels due to asymmetric ice shedding, and restricted forward visibility are a few of these problem areas. A simple, low-cost solution to asymmetric ice shedding from rotor systems is urgently needed to give the helicopter an all-weather capability. Author

N75-10933* Technology, Inc., Dayton, Ohio. Instruments and Controls Div.

STATISTICAL ANALYSIS OF GENERAL AVIATION VG-VGH DATA

Larry E. Clay, Raymond L. Dickey, Martin S. Moran, Kenneth W. Payauys, and Thomas P. Severyn [1974] 134 p refs

(Contract NAS1-12389)

(NASA-CR-132531) Avail: NTIS HC \$5.75 CSCL 01B

To represent the loads spectra of general aviation aircraft operating in the Continental United States, VG and VGH data collected since 1963 in eight operational categories were processed and analyzed. Adequacy of data sample and current operational categories, and parameter distributions required for valid data extrapolation were studied along with envelopes of equal probability of exceeding the normal load factor ($n_{sub z}$) versus airspeed x or gust and maneuver loads and the probability of exceeding current design maneuver, gust, and landing impact $n_{sub z}$ limits. The significant findings are included. Author

N75-10934* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

OPERATING EXPERIENCES OF RETARDANT BOMBERS DURING FIREFIGHTING OPERATIONS

Joseph W. Jewel, Jr., Garland J. Morris, and Donald E. Avery Nov. 1974 23 p refs

(NASA-TM-X-72622) Avail: NTIS HC \$3.25 CSCL 01C

Data are presented on operational practices and maneuver accelerations experienced by two Douglas DC-6B airplanes converted to retardant bombers and used in firefighting operations. The data cover two fire seasons in the mountainous regions of the northwestern United States. Author

N75-10936* National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.

A REMOTELY AUGMENTED VEHICLE APPROACH TO FLIGHT TESTING RPV CONTROL SYSTEMS

Dwain A. Deets and John W. Edwards Nov. 1974 26 p

(NASA-TM-X-56029; H-870) Avail: NTIS HC \$3.75 CSCL 01C

A remotely augmented vehicle concept for flight testing advanced control systems was developed as an outgrowth of a remotely piloted research vehicle (RPV) program in which control laws are implemented through telemetry uplink and downlink data channels using a general purpose ground based digital computer which provides the control law computations. Some advantages of this approach are that the cost of one control system facility is spread over a number of RPV programs, and control laws can be changed quickly as required, without changing the flight hardware. The remotely augmented vehicle concept is described, and flight test results from a subscale F-15 program are discussed. Suggestions of how the concept could lead to more effective testing of RPV control system concepts, and how it is applicable to a military RPV reconnaissance mission are given. Author

N75-10937* Massachusetts Inst. of Tech., Cambridge. Measurement Systems Lab.

A PASSIVE WINGTIP LOAD ALLEVIATION SYSTEM

Raymond B. Harlan and John J. Deyst Oct. 1974 11 p
(Grant NGR-22-009-571)

(NASA-CR-140758) Avail: NTIS HC \$3.25 CSCL 01C

A passive wingtip load alleviation system was devised, tested, and analyzed for its effect on the reduction of structural deformations and the extension of flutter speed. The sensors responded to changes in angle of attack and vertical movement of the wingtip and were used to deflect a trailing edge flap to alleviate the induced loads. Author

N75-10939* Army Aviation Systems Command, St. Louis, Mo. EXECUTIVE SUMMARY REPORT: COMMAND STATISTICS AND EVIDENCED PROBLEMS Final Report
Jul. 1974 40 p

(AD-782990; USAAVSCOM-TR-74-26) Avail: NTIS CSCL 01/3

The Command Statistics and Evidenced Problem Summary is intended to be a brief but informative presentation of compiled statistics and significant observations for the CH-54A aircraft as it appears in the US Army inventory. The primary use of this report will be to serve the management level with a rapid summary of the CH-54A's usage, Reliability, Availability, and Maintainability characteristics, and the means of identifying and solving its problem areas. The Command Statistics and Evidenced Problem Summary is derived directly from the CH-54A Management Summary Report (MSR), dated 24 September 1973. The MSR should therefore be used as a reference document for a more detailed explanation of the data presented here in this summary. The other reports forming the total Executive Summary are the CH-54A Assessment and Comparative Fleet Evaluations and Quality and Command Programs Assessment. Author (GRA)

N75-10940* Lockheed-California Co., Burbank.

DEVELOPMENT AND EXPERIMENTAL VERIFICATION OF PROCEDURES TO DETERMINE NONLINEAR LOAD-DEFLECTION CHARACTERISTICS OF HELICOPTER SUBSTRUCTURES SUBJECTED TO CRASH FORCES. VOLUME 1: DEVELOPMENT OF SIMPLIFIED ANALYTICAL TECHNIQUES TO PREDICT TYPICAL HELICOPTER AIRFRAME CRUSHING CHARACTERISTICS AND THE FORMULATION OF DESIGN PROCEDURES Final Report
G. Wittlin and K. C. Park May 1974 251 p refs
(Contract DAAJ02-73-C-0051; DA Proj. 1F1-62205-AH-88)
(AD-784191; USAAMRD-TR-74-12A-Vol-1) Avail: NTIS CSCL 01/3

The results of a study to develop simplified design procedures for determining nonlinear load-deflection characteristics for helicopter airframe structures are presented in a two-volume report. Volume one describes 60 technical reports and papers with regard to their applicability to crashworthiness analysis and designer-oriented procedures. Studies were made using an existing 31 lumped mass model of the UH-1H helicopter to determine

the sensitivity of responses to changes in load-deflection representations. Twelve transmission pylon specimens were fabricated and static and dynamic tests were performed. (Modified author abstract) GRA

N75-10941* United Air Lines, Inc., Chicago, Ill. FLEET RETROFIT REPORT

30 Jul. 1973 22 p refs

(Contract NAS2-7208)

(NASA-CR-137586) Avail: NTIS HC \$3.25 CSCL 01D

Flight tests are evaluated of an avionics system which aids the pilot in making two-segment approaches for noise abatement. The implications are discussed of equipping United's fleet of Boeing 727-200 aircraft with two-segment avionics for use down to Category 2 weather operating minima. The experience is reported of incorporating two-segment approach avionics systems on two different aircraft. The cost of installing dual two-segment approach systems is estimated to be \$37,015 per aircraft, including parts, labor, and spares. This is based on the assumption that incremental out-of-service and training costs could be minimized by incorporating the system at airframe overhaul cycle and including training in regular recurrent training. Accelerating the modification schedule could add up to 50 percent to the modification costs. Recurring costs of maintenance of the installation are estimated to be of about the same magnitude as the potential recurrent financial benefits due to fuel savings. Author

N75-10943* Lockheed-California Co., Burbank.

ADVANCED SUPERSONIC TECHNOLOGY CONCEPT STUDY: HYDROGEN FUELED CONFIGURATION Final Report, Jul. - Dec. 1973

G. D. Brewer Jan. 1974 326 p refs

(Contract NAS2-7732)

(NASA-CR-114718; LR-26323) Avail: NTIS HC \$9.50 CSCL 21D

Conceptual designs of hydrogen fueled supersonic transport configurations for the 1990 time period were developed and compared with equivalent technology Jet A-1 fueled vehicles to determine the economic and performance potential of liquid hydrogen as an alternate fuel. Parametric evaluations of supersonic cruise vehicles with varying design and transport mission characteristics established the basis for selecting a preferred configuration which was then studied in greater detail. An assessment was made of the general viability of the selected concept including an evaluation of costs and environmental considerations, i.e., exhaust emissions and sonic boom characteristics. Technology development requirements and suggested implementation schedules are presented. Author

N75-10944* Pratt and Whitney Aircraft, East Hartford, Conn. TWO-STAGE FAN. 2: DATA AND PERFORMANCE WITH REDESIGNED SECOND STAGE ROTOR UNIFORM AND DISTORTED INLET FLOWS

H. E. Messenger and M. J. Keenan Oct. 1974 352 p refs
(Contract NAS3-13494)

(NASA-CR-134710; PWA-5087) Avail: NTIS HC \$10.00 CSCL 21E

A two-stage fan with a first rotor tip speed of 1450 ft/sec (441.96 m/sec) and no inlet guide vanes was tested with uniform and distorted inlet flows, with a redesigned second rotor having a part span shroud to prevent flutter, with variable-stagger stators set in nominal positions, and without rotor casing treatment. The fan achieved a pressure ratio 2.8 at a corrected flow of 185.4 lbm/sec (84.0 kg/sec), an adiabatic efficiency of 85.0 percent, and a stall margin of 12 percent. The redesigned second rotor did not flutter. Tip radial distortion reduced the stall margin at intermediate speed, but had little effect on stall margin at high or low speeds. Hub radial distortion reduced the stall margin at design speed but increased stall margin at low speed. Circumferential distortion reduced stall pressure ratio and flow to give approximately the same stall lines with uniform inlet flow. Distortions were attenuated by the fan. Author

N75-10945*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

A COMPARISON OF OPTIMUM JP AND LH2 TURBOFAN ENGINES DESIGNED FOR TWO SUBSONIC TRANSPORT MISSIONS

Kestutis C. Civinskas Oct. 1974 48 p refs
(NASA-TM-X-71622; E-8145) Avail: NTIS HC \$3.75 CSCL 21E

The use of liquid hydrogen fuel instead of JP fuel for two subsonic commercial transports was examined. The following determinations which are important to meeting noise reduction requirements were calculated: (1) take off gross weight, (2) energy consumption, and (3) direct operating costs. The optimum engine cycles were found to be the same for both fuels. Author

N75-10947*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.

SINGLE-STAGE EXPERIMENTAL EVALUATION OF TANDEM-AIRFOIL ROTOR AND STATOR BLADING FOR COMPRESSORS, PART 8 Final Report

J. A. Brent and D. R. Clemmons Nov. 1974 99 p refs
(Contract NAS3-11158)
(NASA-CR-134713; FR-6247-Pt-8) Avail: NTIS HC\$4.75 CSCL 21E

An experimental investigation was conducted with an 0.8 hub/tip ratio, single-stage, axial flow compressor to determine the potential of tandem-airfoil blading for improving the efficiency and stable operating range of compressor stages. The investigation included testing of a baseline stage with single-airfoil blading and two tandem-blade stages. The overall performance of the baseline stage and the tandem-blade stage with a 20-80% loading split was considerably below the design prediction. The other tandem-blade stage, which had a rotor with a 50-50% loading split, came within 4.5% of the design pressure rise ($\Delta P(\text{bar})/P(\text{bar})$ sub 1) and matched the design stage efficiency. The baseline stage with single-airfoil blading, which was designed to account for the actual rotor inlet velocity profile and the effects of axial velocity ratio and secondary flow, achieved the design predicted performance. The corresponding tandem-blade stage (50-50% loading split in both blade rows) slightly exceeded the design pressure rise but was 1.5 percentage points low in efficiency. The tandem rotors tested during both phases demonstrated higher pressure rise and efficiency than the corresponding single-airfoil rotor, with identical inlet and exit airfoil angles. Author

N75-10948*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

NOISE OF MODEL TARGET TYPE THRUST REVERSERS FOR ENGINE-OVER-THE-WING APPLICATIONS

James R. Stone and Orlando A. Gutierrez 1974 24 p refs
Presented at the 88th Meeting of the Acoust. Soc. of Am., St. Louis, 5-8 Nov. 1974
(NASA-TM-X-71621; E-8142) Avail: NTIS HC \$3.25 CSCL 01C

The results of experiments on the noise generated by V-gutter and semicylindrical target reversers with circular and short-aspect-ratio slot nozzles having diameters of about 5 cm are presented. The experiments were conducted with cold-flow jets at velocities from 190-290 m/sec. The reversers at subsonic jet velocities had a more uniform noise distribution and higher frequency than the nozzles alone. The reverser shape was shown to be more important than the nozzle shape in determining the noise characteristics. The maximum sideline pressure level varied with the sixth power of the jet velocity, and the data were correlated for angles along the sideline. An estimate of the noise level along the 152 m sideline for an engine-over-the-wing powered-lift airplane was made. Author

N75-10957# Little (Arthur D.), Inc., Cambridge, Mass.
EVALUATION OF AUXILIARY AGENTS AND SYSTEMS FOR AIRCRAFT GROUND FIRE SUPPRESSION, PHASE 2 Final

Report, 9 Aug. 1972 - 10 Dec. 1973

Sami Atallah and R. Scott Stricoff May 1974 116 p refs.
(Contract F33657-72-C-0422)

(AD-784924; ADL-C-74159-2; ASD-TR-73-41) Avail: NTIS CSCL 13/12

An experimental program was conducted to assess the capabilities of three extinguishing agents under similar fire test conditions. The agents tested were a carbamic powder (CP), halon 1211, and an experimental modification of potassium bicarbonate (PKX). Tests were first conducted to select appropriate nozzles and operating pressures for PKX portable and wheeled extinguishers and halon 1211 portable units. The operating characteristics of portable and wheeled units for all three agents tested are provided. Fire extinguishing tests were next conducted on reproducible configurations simulating interior and exterior aircraft fire conditions. Interior fires included electrical fires, compartment fires involving various individual and mixed fuels and hidden oil fires. Exterior fires included those occurring in helicopter engine stacks, engine nacelles, the reticulated foam of some aircraft tanks, and those involving fuel burning on aircraft wings and cascading fuel fires. (Modified author abstract) GRA

N75-10958# Air Force Weapons Lab., Kirtland AFB, N.Mex.
SKID RESISTANCE TESTS IN SUPPORT OF THE F-4 RAIN TIRE PROGRAM AT THE AIR FORCE FLIGHT TEST CENTER Final Report, Mar. - Aug. 1973

Phil V. Compton Jun. 1974 161 p
(AF Proj. 683M)

(AD-784801; AFWL-TR-74-90) Avail: NTIS CSCL 01/5

A summary of the significant test results from the skid-resistance test program conducted to support the F-4 rain tire program is presented. Testing was conducted with both the mu meter and diagonally braked vehicle (DBV). The results of the testing indicated that the traction properties generally decrease toward the touchdown end of the 8000-foot aircraft test area. This was a result of the water being applied in a direction toward the touchdown end of the test section. A potential for hydroplaning does exist in these ranges of skid-resistance values, and the wet conditions present during the F-4 rain tire program are considered representative of a potential hazardous runway condition. (Modified author abstract) GRA

N75-10959# New Mexico Univ., Albuquerque. Eric H. Wang
Civil Engineering Research Facility.

EVALUATION OF CONSTRUCTION TECHNIQUES FOR NEW ANTIHYDROPLANING OVERLAYS Final Report, Feb. 1973 - Feb. 1974

Emil R. Hargett Jun. 1974 58 p
(Contract F29601-74-C-0030; AF Proj. 683M)

(AD-784870; AFWL-TR-74-77) Avail: NTIS CSCL 01/5

Runway surfaces that will prevent hydroplaning of highspeed jet aircraft during wet weather operations have become a primary requisite for airfields operated by the Air Force and the civilian aviation community. This report describes the materials, construction techniques, and results obtained from a program of field testing addressed to the need for antihydroplaning surfaces. The materials selected for field testing consisted of friction-textured asphalt slurry, Palmer-Pavetread, porous asphalt cold mix, porous asphalt hot mix with latex rubber, and a porous aggregate structure with a resinous binder (Bondate). The construction of test surfaces from these materials, with the exception of Bondate, are described. Special emphasis is given to the construction techniques and construction problems associated with the use of the new materials. (Modified author abstract) GRA

N75-10960# Illinois Univ., Savoy. Aviation Research Lab.
USES OF A VISUAL LANDING SYSTEM IN PRIMARY FLIGHT TRAINING

Linda L. Young, Richard S. Jensen, and Curtis W. Traiche Oct. 1973 10 p refs
Presented at the 17th Ann. Meeting of the Human Factors Soc., Washington, D. C., 16-18 Oct. 1973

(Contract F44620-70-C-0105; AF Proj. 9778)
(AD-784888; ARL-73-26/AFOSR-73-17; AFOSR-74-1350TR)
Avail: NTIS CSCL 05/9

An exploratory study was made to determine the potential usefulness of a visual landing system in a primary flight training program and to determine design and instructional changes which may be necessary to optimize the landing trainer. Thirty-eight flight-naïve student-subjects were divided into three groups, each receiving a different type of simulator landing instruction: Visual Landing System (VLS), Standard GAT-1 (SG), and Control (C). The criterion was three consecutive unassisted landings in a Cherokee 140. The primary measure was flight instruction time needed to reach criterion. Comments from flight instructors and students demonstrated an attitude of high optimism concerning the potential of the VLS as an aid to teaching landings. (Modified author abstract) GRA

N75-10961# Factory Mutual Research Corp., Norwood, Mass.
FIRE PROTECTION OF LARGE AIR FORCE HANGARS. Final Report, Dec. 1972 - Apr. 1974

L. M. Krasner, P. J. Chicarello, and P. M. Fitzgerald Jul. 1974 41 p refs

(Contract F29601-73-C-0043; AF Proj. 683K)

(AD-784869; AFWL-TR-74-23) Avail: NTIS CSCL 13/12

The report describes a study dealing with the fire protection of large Air Force hangars. The text includes discussion of aircraft tolerance to fire exposure (by both direct flame impingement and radiative and convective heat transfer), detection systems for primary and supplementary system actuation in hangars, oscillating monitor nozzles for ground level protection in hangars, and testing of several foam agents in combination with several types of discharge devices suitable for deluge systems. The emphasis of the study was on the test program. A series of non-fire foam quality tests were conducted as well as 900 sq ft JP-4 fire tests discharging Aqueous Film - Forming Foam (AFFF) as the suppressing agent from a deluge system located 60 ft above the fuel surface. (Modified author abstract) GRA

N75-11114# Purdue Univ., Lafayette, Ind. Thermal Sciences and Propulsion Center.

STUDIES OF SLURRY FUELED PROPULSION SYSTEMS Semiannual Progress Report, 1 Feb. - 31 Jul. 1973

Bruce A. Reese and Harry M. Carbone Sep. 1973 50 p refs (AD-784362; TSPC-TM-73-5; SAPR-7) Avail: NTIS CSCL 21/4

The results of the experimental investigation of the combustion efficiencies of selected fuels, JP-5, 75% Aluminum/25% Decalin, 30% Carbon/70% TH Dimer, Shell-dyne, and Boron slurry, burned in sudden dump combustors are presented and discussed.

Author (GRA)

N75-11115# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.

LUBRICITY OF JET A-1 AND JP-4 FUELS. Final Report

Joseph Petrarca, Jr. Jun. 1974 72 p refs (AF Proj. 3048)

(AD-784772; AFAPL-TR-74-15) Avail: NTIS CSCL 21/4

This report describes the evaluation of an instrument that gives an indication of the lubricity of a fuel and of the results from testing Jet A-1 and JP-4 fuels with the device. The instrument is the Furey Ball-on-Cylinder. The preliminary investigation dealt with establishing the repeatability and reproducibility of the rig on pure hydrocarbons and Jet A-1 fuels. Also, the results from the Jet A-1 fuels served as the basis for a direct comparison between the wear scar diameter from the Ball-on-Cylinder and the coefficient of friction from the Bendix-CRC Lubricity Simulator. The Jet A-1 fuels which were composed of a high percentage of heavy end hydrocarbons had the best lubricity. In a similar manner, JP-4 fuels which contained corrosion inhibitors, were tested on the Ball-on-Cylinder and the wear scar diameters obtained were compared to the fuels properties. No correlations were found. (Modified author abstract) GRA

N75-11117# Illinois Univ., Urbana. Dept. of Aeronautical and Astronautical Engineering.

AGENDA AND ABSTRACTS 1974 AFOSR CONTRACTORS MEETING ON UNCONFINED DETONATION AND FUEL-AIR EXPLOSION RELATED RESEARCH. Interim Report

Roger A. Strehlow Jun. 1974 46 p refs Conf. held at Eglin AFB, Fla., 13-14 Jun. 1974

(Grant AF-AFOSR-2524-73; AF Proj. 9711)

(AD-783253; AFOSR-74-1284TR) Avail: NTIS CSCL 19/1

The report consists of a collection of abstracts of the numerous research progress reports given by AFOSR contractors and of invited papers from other governmental agencies and CONUS and European contractors. These papers presented over a two-day period composed the 1974 annual contractors meeting on combustion dynamics associated with fuel-air explosion phenomena. The principal investigators and their organizational association are also identified. Author (GRA)

N75-11154# Royal Aircraft Establishment, Farnborough (England).

NUMBER OF BARS AND TORQUE OF SQUIRREL CAGE ROTORS

W. Stiel Jun. 1974 22 p refs Transl. into ENGLISH from Z. Vereines Deutsch. Ing., v. 65, no. 6, 19212 p 147-152

(RAE-Lib-Trans-1781; BR42315) Avail: NTIS HC \$3.25

Investigations on an asynchronous ac motor with eleven squirrel cage rotors with various numbers of bars are described. Torque curves were obtained using a spring dynamometer. Evaluation of the research data shows that the number of rotor slots must be smaller than that of the stator slots, must differ as little as possible from the latter, must be divisible by the number of poles, and must be an even number; the differences 1, 3, 5 ... in the number of bars are to be avoided. Author

N75-11199* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TRANSONIC COMPRESSOR TECHNOLOGY ADVANCEMENTS

William A. Benser / In Pennsylvania State Univ. Fluid Mech., Acoustics, and Design of Turbomachinery, Pt. 2 1974 p 581-602 refs

CSCL 13K

The highlights of the NASA program on transonic compressors are presented. Effects of blade shape and throat area on losses and flow range are discussed. Some effects of casing treatment on stall margin are presented. Results of tests with varying solidity are also presented. High Mach number, highly loaded stators are discussed and some results of stator hub slit suction are presented. Author

N75-11230# Naval Postgraduate School, Monterey, Calif.

EXPERIMENTAL HYDRAULIC RAM STUDIES (FY 74) Final Report, 1 Jul. 1973 - 30 Jun. 1974

H. L. Power 1 Aug. 1974 70 p refs

(AD-784736; NPS-57PH74081) Avail: NTIS CSCL 01/3

The document is a report on the progress of FY74 experimental hydraulic ram studies. Penetration, shock, and drag phases of hydraulic ram were studied to understand this complicated phenomenon. Author (GRA)

N75-11241 Joint Publications Research Service, Arlington, Va.
EFFECT OF THE ROTATION RATE OF THE ROTOR ON THE ANGULAR RIGIDITY OF THE ELASTIC SUSPENSION OF A HOUVE GYROSCOPE

M. V. Polymskikh / In its Guidance Technol. (JPRS-63339) 31 Oct. 1974 p 1-4 refs Transl. into ENGLISH from Priboorostroyeniye (Moscow), no. 6, 1974 p 62-64

The divergence in the angular rigidity of the torsions of an operating and stationary Houve gyroscope is noted. A formula is presented for determining this divergence as applied to thin-walled torsions of cruciform cross section. Author

N75-11359# Air Force Materials Lab., Wright-Patterson AFB, Ohio.

INVESTIGATION AND OPTIMIZATION OF MICRO-OXIDATION TECHNIQUES EMPLOYED IN GAS TURBINE ENGINE OIL CHARACTERIZATION Technical Report, May 1967 - Dec. 1970

Eilhard Jantzen, G. Spengler, and George J. Morris May 1974 44 p refs Prepared in cooperation with DFVLR, Munich (AF Proj. 7343)

(AD-784787; AFML-TR-74-11) Avail: NTIS CSCL 11/8

Rationale is provided which led to a modified oxidation-corrosion (O-C) test. Test methods, apparatus, and procedures are described for use up to 800F, a 20 milliliter amount of sample oil and a test time of 24 hours. The influence of various important parameters on oxidation-corrosion are presented. The reduction of the test duration to 24 hours was optimized. Oxidation/corrosion studies at several different temperatures and the resulting oil deterioration curves were shown to be meaningful from a minimum of 392F to a maximum of 700F. The selection of the proper air flow was coupled with the reduced sample size as most appropriate for this work. The selection of high purity metal catalysts was justified. Analysis methods used in this work and their relative merits are discussed. Finally oxidation-corrosion data is presented on a few typical base stocks using this method. (Modified author abstract) GRA

N75-11372*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

THE PREDICTION OF STRUCTURAL RESPONSE TO BUFFET FLOW: A STATE-OF-THE-ART REVIEW

Perry W. Hanson Dec. 1974 23 p refs Presented at 39th AGARD Structural and Mater. Meeting, Munich, 7-12 Oct. 1974

(NASA-TM-X-72627; L-9820) Avail: NTIS HC \$3.25 CSCL 20K

Certain aspects of the dynamic system being discussed are reviewed and important structural and aerodynamic quantities of the system are discussed. A theoretical model is presented which relates these quantities to each other. These quantities are then each, in turn, considered in terms of the state of the art of determining the quantities and in terms of areas where further research is needed. The similarity laws and scaling relationships applicable to determining buffet structural response are then discussed, and areas where simplification is required or may be permissible are mentioned. Finally, the various types of model tests pertinent to predicting response of the aircraft structure to buffet flow are discussed. Author

N75-11764# Avco-Everett Research Lab., Everett, Mass.

DEVELOPMENT OF EXPLOSIVELY DRIVEN MHD GENERATOR FOR SHORT PULSE AIRCRAFT HIGH POWER. PART 1: ANALYTICAL STUDIES. PART 2: EXPERIMENTAL STUDIES. PART 3: DESIGN STUDIES Interim Technical Report

J. Teno and O. K. Sonju Jun. 1974 476 p refs

(Contract F33615-72-C-1395; AF Proj. 3145)

(AD-784903; AFAPL-TR-74-48; ITR-1) Avail: NTIS CSCL 10/2

The main objective of the work was feasibility demonstration of compact high performance explosively driven MHD generators. The work performed here was of both an analytical and experimental nature, including studies of explosives, detonation, expansion of detonation products, evaluation of the conductivity of expanded gases resulting from detonation of the explosive charge. This work provides a sound foundation for work that may be conducted in the future and would permit such a program to begin with the fabrication of a model high performance test XMHD generator. Author (GRA)

N75-11797 Joint Publications Research Service, Arlington, Va. **RESISTANCE OF RADAR SYSTEMS AGAINST INTERFERENCE**

Khristo Popov *In its* Transl. on Eastern Europe, No. 436 (JPRS-63373) 6 Nov. 1974 p 1-7 Transl. into ENGLISH from Voenna Tekhnika (Sofia), no. 8, 1974 p 26-28

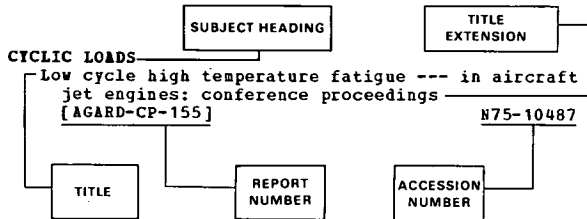
A mathematical model was developed by Bulgarian scientists which calculates the range of detection of a silent target (an aircraft which does not create disturbances, but flies under the cover of disturbances created by interference aircraft) of a given radar system, and several effective means are discussed for upgrading the individual protection of radar systems from active noise interference. A.A.D.

SUBJECT INDEX

AERONAUTICAL ENGINEERING /A Special Bibliography (Suppl. 54)

FEBRUARY 1975

Typical Subject Index Listing



The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, a title extension is added, separated from the title by three hyphens. The NASA or AIAA accession number is included in each entry to assist the user in locating the abstract in the abstract section of this supplement. If applicable, a report number is also included as an aid in identifying the document.

A

ABLATIVE MATERIALS

Aerospace Research --- topics on airfoil profiles, flow visualization, ablative materials, microanalysis, and filter analysis
[ESRO-TT-90] N75-10011

ACCELERATED LIFE TESTS

Development of accelerated life testing techniques for general failure modes of aircraft hardware
[AD-784188] N75-10073

ACOUSTIC MEASUREMENTS

Comparison of the acoustic characteristics of large-scale models of several propulsive-lift concepts
[AIAA PAPER 74-1094] A75-10278

Acoustics of the sonic boom --- Book A75-13023

From creaking cracks to breaking beams - A review of acoustic emission for aircraft structure A75-13035

Effective data monitoring during airplane flyover noise tests N75-10928

ACRYLIC RESINS

Polycarbonate aircraft transparencies A75-13041

ADAPTIVE CONTROL

Performance improvement through control configured vehicle concept --- active control systems for aircraft life augmentation
[NASA-TT-F-15998] N75-10059

ADHESION

Improved primer coating systems for the transportation industries A75-13043

ADHESIVE BONDING

Selected problems concerning the strength of a bonded heavily loaded Dural structure A75-12475
Laminated metallic structure - Advanced applications A75-13046

AERIAL RUDDERS

Analysis of multihinge tailplane with account for control surface deflection A75-12088

AERODYNAMIC CHARACTERISTICS

The externally-blown jet flap - A powered-lift concept for STOL A75-11085

Fundamental geometric and aerodynamic characteristics of aircraft and finned rockets --- Russian book A75-11577

High-performance centrifugal compressors A75-11739

Calculation of the aerodynamic characteristics of a system of rectangular wings moving near a screening surface A75-12078

Experimental study of spanwise air jet influence on wing aerodynamic characteristics A75-12096

Some problems of the canard configuration. I A75-12473

Hingeless rotorcraft flight dynamics --- research projects to analyze aerodynamic characteristics of rotary wings
[AGARD-AG-197] N75-10003

AERODYNAMIC COEFFICIENTS

Extraction from flight data of lateral aerodynamic coefficients for F-8 aircraft with supercritical wing
[NASA-TN-D-7749] N75-10006

AERODYNAMIC CONFIGURATIONS

Roll-up of aircraft trailing vortices using artificial viscosity A75-12620

Wind tunnel tests of modified cross, hemisflo, and disk-gap-band parachutes with emphasis in the transonic range
[NASA-TN-D-7759] N75-10007

Application of the polar coordinate method to oscillating wing configurations
[SAAB-TN-69] N75-10010

High acceleration cockpits for advanced fighter aircraft. Volume 4: Test results
[AD-783603] N75-10067

A viscous/potential flow interaction analysis method for multi-element infinite swept wings, volume 1
[NASA-CR-2476] N75-10358

Results of full-scale vortex attenuation flight experiments N75-10931

AERODYNAMIC DRAG

A test technique for inlet/aircraft drag evaluation
[AIAA PAPER 74-1145] A75-10306

A flow field model for, and some studies on the drag of, an engine exhaust system at transonic flight speeds
[AIAA PAPER 74-1175] A75-10325

Resolving the contradictions between airplane component weight and drag A75-12077

AERODYNAMIC FORCES

Aerodynamic torques on rotating oblate spheroids A75-11151

Generation of aerodynamic profiles and establishing the circulation around a wing by deformation of the wing A75-12638

Wind tunnel tests of modified cross, hemisflo, and disk-gap-band parachutes with emphasis in the transonic range
[NASA-TN-D-7759] N75-10007

Application of the polar coordinate method to oscillating wing configurations
[SAAB-TN-69] N75-10010

Aerodynamic symmetry of aircraft and guided missiles --- development of configurations to eliminate certain force and moment derivatives
[AD-784254] N75-10070

AERODYNAMIC INTERFERENCE

SUBJECT INDEX

AERODYNAMIC INTERFERENCE

Statistical averages of subsonic inlet distortion
[AIAA PAPER 74-1197] A75-10342

AERODYNAMIC LOADS

Loadings and flight limitations of the sailplane
having the speed flap. I A75-10721

A passive wingtip load alleviation system
[NASA-CR-140758] N75-10937

AERODYNAMIC NOISE

Turbofan noise reduction using a near sonic inlet
[AIAA PAPER 74-1098] A75-10281

AERODYNAMIC STABILITY

Techniques for improving the stability of soft
inplane hingeless rotors
[NASA-TM-X-62390] N75-10058

The CCV concept and specifications
[NASA-TT-F-15997] N75-10060

AERODYNAMIC STALLING

Investigation of the effects of blade structural
design parameters on helicopter stall boundaries
[AD-784594] N75-10075

AERODYNAMICS

Applied aerodynamics --- Russian book on
experimental methods, measurement and
calculation techniques A75-13026

AEROELASTICITY

Automated structural design with aeroelastic
constraints - A review and assessment of the
state of the art A75-11624

Investigations involving a 'dynamically similar'
component model of the VFW 614 - Experimental
determination of the fundamental oscillation
parameters A75-11673

Calculation of helicopter main rotor blade
deformation with account for control flexibility
A75-12087

Influence of airplane structural elasticity on
flight safety and comfort in turbulent atmosphere
A75-12098

Static aeroelasticity and the flying wing, revisited
A75-12622

Lifting surface theory applied to fixed wings and
propellers N75-10016

AERONAUTICAL ENGINEERING

Critical analyses and laboratory research work at
the stage of aircraft preliminary design
[NASA-TT-F-15996] N75-10055

AEROSPACE ENGINEERING

Applied aerodynamics --- Russian book on
experimental methods, measurement and
calculation techniques A75-13026

AEROSPACE VEHICLES

On computer-aided design of aerospace vehicles
A75-11626

AFTERBODIES

F-15 nozzle/afterbody integration
[AIAA PAPER 74-1100] A75-10283

AFTERBURNING

Exhaust nozzle deflector systems for V/STOL
fighter aircraft
[AIAA PAPER 74-1169] A75-10320

AIR CARGO

An exploratory flight investigation of helicopter
sling-load placements using a closed-circuit
television as a pilot aid
[NASA-TN-D-7776] N75-10009

AIR INTAKES

A critique of the F-14A air inlet control system -
From development to production status
[AIAA PAPER 74-1060] A75-11278

AIR JETS

Experimental study of spanwise air jet influence
on wing aerodynamic characteristics A75-12096

AIR NAVIGATION

Flight management - Pilot procedures and system
interfaces for the 1980-1990's
[AIAA PAPER 74-1297] A75-12248

Safety and air navigation A75-12372

Navigation in the use of helicopters offshore
A75-12373

AIR POLLUTION

Noise and atmospheric emissions - An airline view
A75-11083

The 1973 program of measurement of the minor
constituents of the stratosphere using the
Concorde 001 A75-11720

AIR TO AIR MISSILES

Development of Slip Cast Fused Silica radomes
A75-10870

AIR TRAFFIC CONTROL

ATC implications of the 747 SP A75-11092

Simulation studies of STOL airplane operations in
metropolitan downtown and airport air traffic
control environments
[NASA-TN-D-7740] N75-10038

AIR TRANSPORTATION

Helicopter - People and places /14th Cierva
Memorial Lecture/ --- emphasizing safety factors
and passenger travel A75-10187

A policy study of subsidized air service
[AIAA PAPER 74-1274] A75-11111

Optimal competition in high density markets
[AIAA PAPER 74-1275] A75-11112

Certain problems of fuel consumption in air
transport A75-11372

Avionics systems in the management of air
transportation
[AIAA PAPER 74-1294] A75-12246

Design objectives - Air transportation A75-13029

Proposed international air shuttle, 1975
[GPO-31-527] N75-10034

AIRBORNE EQUIPMENT

Electromagnetic compatibility assurance tests for
airborne systems controls in an RF-polluted
environment A75-10279

The 1973 program of measurement of the minor
constituents of the stratosphere using the
Concorde 001 A75-11720

AIRBORNE/SPACEBORNE COMPUTERS

Aids - Expectations past, present and future ---
Airborne Integrated Data System A75-10260

[AIAA PAPER 74-1067] A75-10260

Fly-by-wire is here --- fighter aircraft flight
control A75-12825

S-3A Viking - Carrier's shield A75-13149

AIRCRAFT ACCIDENTS

Safety and air navigation A75-12372

Failure analyses of aircraft accidents. II A75-12726

Annual review of aircraft accident data: US
General Aviation calendar year 1971
[NTSB-ARG-74-2] N75-10037

AIRCRAFT ANTENNAS

State of radome technology - 1974; Proceedings of
the Twelfth Symposium on Electromagnetic
Windows, Georgia Institute of Technology,
Atlanta, Ga., June 12-14, 1974 A75-10851

EM window thermal barriers --- on supersonic
aircraft A75-10857

Radomes for high gain arrays A75-10858

B-1 forward radome A75-10866

Radio frequency heating of radomes in an
aerodynamic environment A75-10876

Aircraft-velocity measurement through
radar-altimeter echo with noncoherent detection
[SLA-74-112] N75-10290

Real-time measuring procedure and measuring
equipment for recording the radiation patterns
of aircraft antennas in flight
[ESRO-TT-74] N75-10292

AIRCRAFT CARRIERS

High sink-rate landing testing of Navy aircraft
A75-10924

SUBJECT INDEX

AIRCRAFT ENGINES

AIRCRAFT COMMUNICATION

Navigation in the use of helicopters offshore
A75-12373

AIRCRAFT CONFIGURATIONS

Fundamental geometric and aerodynamic characteristics of aircraft and finned rockets
--- Russian book

Some problems of the canard configuration. I
A75-11577

Installation benefits of the single-engine exhaust nozzle on the YF-16
[AIAA PAPER 74-1101]
A75-12473

Experimental determination of airplane mass and inertial characteristics
[NASA-TR-R-433]
A75-12571

Aerodynamic symmetry of aircraft and guided missiles
--- development of configurations to eliminate certain force and moment derivatives
[AD-784254]
N75-10062

Operating experiences of retardant bombers during firefighting operations
[NASA-TM-X-72622]
N75-10070

Aircraft control
A response criterion for aircraft with fly-by-wire control systems
A75-10018

Application of methods of abstract algebra to the synthesis of an automatic system for controlling the longitudinal motion of an aircraft
A75-11121

A conceptual approach to applying singular perturbation methods to variational problems --- in optimal control
A75-11895

Avionics systems in the management of air transportation
[AIAA PAPER 74-1294]
A75-12246

An elastic flight vehicle as an automatic control plant --- Russian book
A75-12329

Automated avionics system checkout and monitoring in a flight test environment
N75-10920

A Saab-Scania developed method for obtaining stability derivatives from flight tests
N75-10925

AIRCRAFT DESIGN

Drone/RPV systems --- Remotely Piloted Vehicle as weapon system
A75-10186

The development program for the F-15 inlet
[AIAA PAPER 74-1061]
A75-10256

Inlet development for the B-1 strategic bomber
[AIAA PAPER 74-1064]
A75-10258

F-15 nozzle/afterbody integration
[AIAA PAPER 74-1100]
A75-10283

Test and evaluation of a fighter aircraft in-flight thrust reverser
[AIAA PAPER 74-1170]
A75-10321

Development of an armored T-28 aircraft for probing hailstorms
A75-10638

YC-14 system for leading edge boundary layer control
[AIAA PAPER 74-1278]
A75-11115

YF-16 inlet design and performance
[AIAA PAPER 74-1062]
A75-11279

Next generation transports will emphasize fuel savings
A75-11426

Fuel outlook dictating technical transport research
A75-11427

Analysis of multihinge tailplane with account for control surface deflection
A75-12088

Short SD3-30 --- twin turboprop commuter aircraft with wide body design
A75-12420

Rationale for cost-weight analysis --- in airframe design
[AIAA PAPER 74-961]
A75-13069

S-3A Viking - Carrier's shield
A75-13149

Critical analyses and laboratory research work at the stage of aircraft preliminary design
[NASA-TT-F-15996]
N75-10055

Performance improvement through control configured vehicle concept --- active control systems for aircraft life augmentation
[NASA-TT-F-15998]
N75-10059

The CCV concept and specifications
[NASA-TT-F-15997]
N75-10060

AIRCRAFT ENGINES

Heat and mass transfer in engines of flight vehicles
--- Russian book
A75-10203

Powerplant energy management --- transport aircraft engine thrust control
[AIAA PAPER 74-1066]
A75-10259

The digital electronic propulsion control system - Problems and payoffs
[AIAA PAPER 74-1068]
A75-10261

V/STOL deflector concepts
[AIAA PAPER 74-1168]
A75-10319

Exhaust nozzle deflector systems for V/STOL fighter aircraft
[AIAA PAPER 74-1169]
A75-10320

Rapid calculation of propulsion system installation corrections --- for jet engines
[AIAA PAPER 74-1174]
A75-10324

A flow field model for, and some studies on the drag of, an engine exhaust system at transonic flight speeds
[AIAA PAPER 74-1175]
A75-10325

Small turbine engine technology
[AIAA PAPER 74-1184]
A75-10333

Small flying engines are different --- aircraft gas turbine design
[AIAA PAPER 74-1185]
A75-10334

Sealing technology for aircraft gas turbine engines
[AIAA PAPER 74-1188]
A75-10336

An analytic description of hypermixing and test of an improved nozzle
[AIAA PAPER 74-1190]
A75-10338

A test cell engine diagnostic system - From research to reality
[AIAA PAPER 74-1207]
A75-10349

Gas turbine engines - A state-of-the-art review
A75-10840

Fretting in aircraft turbine engines
A75-10925

A critique of the F-14A air inlet control system - From development to production status
[AIAA PAPER 74-1060]
A75-11278

YF-16 inlet design and performance
[AIAA PAPER 74-1062]
A75-11279

Electronic propulsion controls for commercial aircraft
[AIAA PAPER 74-1065]
A75-11280

F-15 flight test experience with the F100-PW-100 engine
[AIAA PAPER 74-1162]
A75-11297

Recent flight experience with the F100 engine in the YF-16
[AIAA PAPER 74-1163]
A75-11298

Flight-test techniques for obtaining valid comparisons of wind-tunnel and flight results from tests on a YF-12 mixed-compression inlet
[AIAA PAPER 74-1195]
A75-11301

Viper turbojet engines. II --- design and applications
A75-11371

The American STAGG gas generator program
A75-11721

An inexpensive jet engine, dream or reality --- for remotely piloted vehicles
A75-11724

High-performance centrifugal compressors
A75-11739

Effect of erosive wear on aircraft gas turbine engine axial compressor cantilever blade endurance
A75-12106

Reliability and maintainability of aircraft jet engines. II
A75-12125

Optimization of automated static tests of gas turbine engines --- Russian book
A75-12332

Design objectives - Air transportation
A75-13029

Oxide dispersion strengthened alloys for aircraft turbine engine vanes
A75-13040

AIRCRAFT EQUIPMENT

SUBJECT INDEX

- Low cycle high temperature fatigue --- in aircraft jet engines: conference proceedings [AGARD-CP-155] N75-10487
- Precision in LCHTF testing --- of aircraft jet engines N75-10490
- The effect of cycle parameters on high temperature low cycle fatigue --- in aircraft jet engines N75-10491
- Lifetime prediction methods for elevated temperature fatigue --- in aircraft jet engines N75-10493
- Design procedures for elevated temperature low-cycle fatigue --- as applied to aircraft jet engines N75-10494
- A new jet engine thrust measuring system: An advancement in flight test engineering N75-10922
- Transonic compressor technology advancements N75-11199
- AIRCRAFT EQUIPMENT**
- Doppler radar boast design innovations --- for aircraft A75-10625
- A new look at qualification of aircraft equipment A75-12122
- A conceptual definition study for a digital avionics information system (approach 2), volume 1 [AD-780581/5] N75-10071
- A conceptual definition study for a digital avionics information system (approach 2). Volume 2: Appendixes A thru D [AD-780582/3] N75-10072
- Development of accelerated life testing techniques for general failure modes of aircraft hardware [AD-784188] N75-10073
- Determination of the forces in the retractor of a three-dimensional landing gear mechanism [AD-784257] N75-10078
- Technology development report: Results of static electricity discharge system tests (active and passive) heavy lift helicopter [AD-784130] N75-10082
- T and E guidelines for aircraft systems [AD-784549] N75-10085
- T and E guidelines for airborne ECM systems [AD-784574] N75-10332
- Airborne testing of advanced multisensor aircraft N75-10921
- AIRCRAFT FUELS**
- The use of hydrogen in commercial aircraft - An assessment A75-10542
- The use of jet fuels in aviation --- Russian book A75-13000
- Advanced supersonic technology concept study: Hydrogen fueled configuration [NASA-CR-114718] N75-10943
- AIRCRAFT GUIDANCE**
- Automatic flying of curved approach paths: A computer and flight investigation [RAE-TR-73154] N75-10043
- AIRCRAFT HYDRAULIC SYSTEMS**
- MBB BO 105. II - Concept and worldwide use --- helicopter design A75-12525
- MIL-H-83282, fire resistant hydraulic fluid --- for military aircraft A75-13052
- AIRCRAFT INSTRUMENTS**
- Influence of inherent carrier motion on a frequency selection system A75-12060
- Flight management - Pilot procedures and system interfaces for the 1980-1990's [AIAA PAPER 74-1297] A75-12248
- A study on aircraft map display location and orientation A75-12725
- AIRCRAFT LANDING**
- Performance of a model cascade thrust reverser for short-haul applications [AIAA PAPER 74-1171] A75-11299
- Estimation of the characteristics of various flare profiles [ESRO-TT-89] N75-10031
- Developing STOL operational criteria N75-10911
- Flight demonstration of the feasibility of a scanning beam microwave landing system N75-10919
- High sink-rate landing testing of Navy aircraft N75-10924
- Fleet retrofit report [NASA-CR-137586] N75-10941
- Skid resistance tests in support of the F-4 rain tire program at the Air Force Flight Test Center [AD-784801] N75-10958
- Evaluation of construction techniques for new antihydroplaning overlays [AD-784870] N75-10959
- Uses of a visual landing system in primary flight training [AD-784888] N75-10960
- AIRCRAFT MAINTENANCE**
- Improved reliability of turbine engines through common sense maintenance A75-11087
- Reliability and maintainability of aircraft jet engines. II A75-12125
- Operational effectiveness of transport aircraft [NASA-TT-F-810] N75-10036
- Interservice utility helicopter reliability and maintainability comparative analysis [AD-784177] N75-10080
- Executive summary report: Command statistics and evidenced problems --- for HC-54 A helicopter [AD-782990] N75-10939
- AIRCRAFT MANEUVERS**
- YP-16 could advance air combat tactics A75-10017
- AIRCRAFT MODELS**
- A test technique for inlet/aircraft drag evaluation [AIAA PAPER 74-1145] A75-10306
- Investigations involving a 'dynamically similar' component model of the VFW 614 - Experimental determination of the fundamental oscillation parameters A75-11673
- Vibrational investigations on aircraft models in support of flutter calculations A75-11676
- A technique for displaying flight information in the field of view of binoculars for use by the pilots of radio controlled models [NASA-TN-X-72015] N75-10786
- Noise of model target type thrust reversers for engine-over-the-wing applications [NASA-TN-X-71621] N75-10948
- AIRCRAFT NOISE**
- Comparison of the acoustic characteristics of large-scale models of several propulsive-lift concepts [AIAA PAPER 74-1094] A75-10278
- Performance of a model cascade thrust reverser for short-haul applications [AIAA PAPER 74-1171] A75-11299
- Reliability of laboratory tests of VSTOL and other long duration noises [NASA-CR-24711] N75-10093
- A survey of aircraft noise annoyance in an area of invariant noise to eliminate the effects on annoyance of varying noise exposure [TT-7405] N75-10755
- Effective data monitoring during airplane flyover noise tests N75-10928
- AIRCRAFT PERFORMANCE**
- A computer program for aircraft thrust ejector analyses [AIAA PAPER 74-1191] A75-10339
- ATC implications of the 747 SP A75-11092
- Steam rockets for takeoff A75-11373
- Critical review of methods to predict the buffet capability of aircraft [AGARD-R-623] N75-10053
- Transonic buffet behavior of Northrop F-5A aircraft [NASA-CR-140939] N75-10054
- T and E guidelines for aircraft systems [AD-784549] N75-10085
- Advancements in flight test engineering [LC-74-136-52] N75-10910
- Developing STOL operational criteria N75-10911

SUBJECT INDEX

AIRLINE OPERATIONS

- Application of the fast Fourier transform to ground vibration testing, and flight flutter testing
N75-10926
- AIRCRAFT PILOTS**
A study on aircraft map display location and orientation
A75-12725
- AIRCRAFT RELIABILITY**
Aids - Expectations past, present and future ---
Airborne Integrated Data System
[AIAA PAPER 74-1067]
A75-10260
FAA Advisory Circular 00-41 Quality System Certification Program
A75-10675
Improved reliability of turbine engines through common sense maintenance
A75-11087
The SA. 360 'Dauphin' - Definition and development --- helicopter design
A75-11722
A new look at qualification of aircraft equipment
A75-12122
- AIRCRAFT SAFETY**
Lightning protection for advanced aircraft radomes based on the segmented lightning diverter strip
A75-10877
The attainable goal in airline safety
N75-10035
- AIRCRAFT SPECIFICATIONS**
FAA Advisory Circular 00-41 Quality System Certification Program
A75-10675
MBB BO 105. II - Concept and worldwide use --- helicopter design
A75-12525
- AIRCRAFT STABILITY**
The development program for the F-15 inlet
[AIAA PAPER 74-1061]
A75-10256
Development and experimental verification of a technique to test full-scale inlet/engine systems at maneuvering conditions
[AIAA PAPER 74-1199]
A75-10344
Stabilization of the longitudinal motion of a flight vehicle in the presence of a delay in the control forces
A75-11653
Investigations involving a 'dynamically similar' component model of the VFW 614 - Experimental determination of the fundamental oscillation parameters
A75-11673
Influence of inherent carrier motion on a frequency selection system
A75-12060
Stability limits for downsprings --- on light aircraft
A75-12618
Transonic buffet behavior of Northrop F-5A aircraft [NASA-CR-140939]
A75-10054
A study of stabilization techniques for small, fixed-wing, remotely piloted aircraft
[AD-784109]
N75-10079
Yaw axis stability augmentation system flight test report --- flight tests of H-58 helicopter
[AD-784134]
N75-10083
A Saab-Scania developed method for obtaining stability derivatives from flight tests
N75-10925
- AIRCRAFT STRUCTURES**
Practical application of the Howard-Czencow method - Calculation of bent and axially compressed beams. II
A75-11375
Resolving the contradictions between airplane component weight and drag
A75-12077
Influence of airplane structural elasticity on flight safety and comfort in turbulent atmosphere
A75-12098
Selected problems concerning the strength of a bonded heavily loaded Dural structure
A75-12475
A computer automated ultrasonic inspection system for aircraft forgings
A75-12933
From creaking cracks to breaking beams - A review of acoustic emission for aircraft structure
A75-13035
- Polycarbonate aircraft transparencies
A75-13041
Determination of the dynamic characteristics of a structure from a vibration test performed with only one excitation point --- exemplified for aircraft structures
N75-10371
Evaluation of auxiliary agents and systems for aircraft ground fire suppression, phase 2
[AD-784924]
N75-10957
- AIRCRAFT TIRES**
Skid resistance tests in support of the F-4 rain tire program at the Air Force Flight Test Center
[AD-784801]
N75-10958
- AIRCRAFT WAKES**
The stability of a trailing line vortex. II - Viscous theory
A75-10621
Correlation for estimating vortex rotational velocity downstream dependence
A75-12621
Monitoring the Movement of wake vortices at Kennedy and Stapleton Airports
N75-10929
Hot-wire anemometry for in-flight measurement of aircraft wake vortices
N75-10930
Results of full-scale vortex attenuation flight experiments
N75-10931
- AIRFOIL PROFILES**
An extension of the 'parabolic method' to the calculation of transonic flows
A75-10837
Potential flow past annular aerofoils
A75-12619
Low-frequency three-dimensional profile vibrations in transonic gas flow
A75-13132
Aerospace Research --- topics on airfoil profiles, flow visualization, ablative materials, microanalysis, and filter analysis
[ESRO-TT-90]
N75-10011
On the flow around the leading edge of an aerofoil
N75-10012
Methods of visualizing the leading edge separation bubble and analysis of the results
N75-10013
- AIRFOILS**
A method of obtaining sub-critical compressible velocities for two-dimensional aerofoils from an exact inviscid incompressible solution
A75-10189
A wind energy conversion system based on the tracked-vehicle airfoil concept
A75-10518
The nature, development and effect of the viscous flow around an aerofoil with high-lift devices
[ARC-CP-1258]
N75-10021
Single-stage experimental evaluation of tandem-airfoil rotor and stator blading for compressors, part 8
[NASA-CR-134713]
N75-10947
- AIRFRAME MATERIALS**
Emission of smoke and fumes at temperatures up to 500 C
A75-10799
Weldability and quality of titanium alloy weldments
A75-13044
Laminated metallic structure - Advanced applications
A75-13046
- AIRFRAMES**
A test technique for inlet/aircraft drag evaluation
[AIAA PAPER 74-1145]
A75-10306
Rationale for cost-weight analysis --- in airframe design
[AIAA PAPER 74-961]
A75-13069
Development and experimental verification of procedures to determine nonlinear load-deflection characteristics of helicopter substructures subjected to crash forces. Volume 1: Development of simplified analytical techniques to predict typical helicopter airframe crushing characteristics and the formulation of design procedures
[AD-784191]
N75-10940
- AIRLINE OPERATIONS**
Noise and atmospheric emissions - An airline view
A75-11083

AIRPLANE PRODUCTION COSTS

SUBJECT INDEX

A policy study of subsidized air service
[AIAA PAPER 74-1274] A75-11111

Optimal competition in high density markets
[AIAA PAPER 74-1275] A75-11112

The attainable goal in airline safety N75-10035

AIRPLANE PRODUCTION COSTS

Expendable solid propellant boost motors for small target aircraft
[AIAA PAPER 74-1125] A75-10292

Rationale for cost-weight analysis --- in airframe design
[AIAA PAPER 74-961] A75-13069

AIRPORTS

Simulation studies of STOL airplane operations in metropolitan downtown and airport air traffic control environments
[NASA-TN-D-7740] N75-10038

AIRSHIPS

LTA in the USA - Here's where it stands today --- lighter than air vehicles
[AIAA PAPER 74-1280] A75-11116

Some factors affecting the use of lighter than air systems --- economic and performance estimates for dirigibles and semi-buoyant hybrid vehicles
[NASA-TM-X-62374] N75-10004

AIRSPEED

Aircraft-velocity measurement through radar-altimeter echo with noncoherent detection
[SLA-74-112] N75-10290

ALGEBRA

Application of methods of abstract algebra to the synthesis of an automatic system for controlling the longitudinal motion of an aircraft A75-11121

ALUMINUM

Boron/aluminum for space applications A75-13048

ALUMINUM ALLOYS

Selected problems concerning the strength of a bonded heavily loaded Dural structure A75-12475

Evaluating new aluminum forging alloys A75-12729

ANALOG SIMULATION

Analog simulation of the small perturbation equation applied to transonic flows --- and wall and cascade flows N75-10370

ANGLE OF ATTACK

Experimental study of spanwise air jet influence on wing aerodynamic characteristics A75-12096

ANGULAR VELOCITY

Aerodynamic torques on rotating oblate spheroids A75-11151

Correlation for estimating vortex rotational velocity downstream dependence A75-12621

ANISOTROPIC MEDIA

Anisotropic dielectric panel analysis --- for radome materials A75-10859

ANNULAR FLOW

A difference method for axisymmetric supersonic flow in rotating annular cascades with local subsonic regions A75-11045

Potential flow past annular aerofoils A75-12619

ANTENNA ARRAYS

Doppler radar boast design innovations --- for aircraft A75-10625

A prototype four-horn cluster IPF antenna
[AD-784395] N75-10327

ANTENNA RADIATION PATTERNS

Real-time measuring procedure and measuring equipment for recording the radiation patterns of aircraft antennas in flight
[ESRO-TT-74] N75-10292

ANTI-FRICTION BEARINGS

Endurance testing of an LM-726-4 elastomeric pitch change bearing
[AD-784140] N75-10074

Low temperature testing of an AH-1G helicopter equipped with elastomeric flapping and feathering bearings in the main rotor
[AD-784183] N75-10081

ANTISUBMARINE WARFARE AIRCRAFT

S-3A Viking - Carrier's shield A75-13149

APPROACH CONTROL

Estimation of the characteristics of various flare profiles
[ESRO-TT-89] N75-10031

High sink-rate landing testing of Navy aircraft N75-10924

ARMOR

Development of an armored T-28 aircraft for probing hailstorms A75-10638

ATMOSPHERIC COMPOSITION

Atmospheric ozone and its influence on the operation of supersonic transport A75-11639

The 1973 program of measurement of the minor constituents of the stratosphere using the Concorde 001 A75-11720

ATMOSPHERIC ELECTRICITY

Interference with aircraft radio navigation and communications by precipitation static from ice and snow clouds: Electrostatic wind tunnel experiments
[AD-784623] N75-10046

ATMOSPHERIC OPTICS

Preliminary test results of the 'oblique ray' installation --- for atmospheric light transmission A75-11641

ATMOSPHERIC TURBULENCE

Influence of airplane structural elasticity on flight safety and comfort in turbulent atmosphere A75-12098

ATTACK AIRCRAFT

A test cell engine diagnostic system - From research to reality
[AIAA PAPER 74-1207] A75-10349

Mini-BPV's for cheap and no risk air power A75-10623

ATTITUDE INDICATORS

A study on aircraft map display location and orientation A75-12725

AUTOMATIC FLIGHT CONTROL

Application of methods of abstract algebra to the synthesis of an automatic system for controlling the longitudinal motion of an aircraft A75-11121

An elastic flight vehicle as an automatic control plant --- Russian book A75-12329

A remotely augmented vehicle approach to flight testing RPV control systems
[NASA-TM-X-56029] N75-10936

AUTOMATIC LANDING CONTROL

Automatic flying of curved approach paths: A computer and flight investigation
[RAE-TR-73154] N75-10043

AUTOMATIC TEST EQUIPMENT

Optimization of automated static tests of gas turbine engines --- Russian book A75-12332

AUXILIARY PROPULSION

Steam rockets for takeoff A75-11373

AVIONICS

Electromagnetic compatibility assurance tests for airborne systems controls in an RF-polluted environment
[AIAA PAPER 74-1096] A75-10279

Doppler radar boast design innovations --- for aircraft A75-10625

Avionics systems in the management of air transportation
[AIAA PAPER 74-1294] A75-12246

Flight management - Pilot procedures and system interfaces for the 1980-1990's
[AIAA PAPER 74-1297] A75-12248

A conceptual definition study for a digital avionics information system (approach 2), volume 1
[AD-780581/5] N75-10071

A conceptual definition study for a digital avionics information system (approach 2). Volume 2: Appendixes A thru D
[AD-780582/3] N75-10072

SUBJECT INDEX

CERTIFICATION

Automated avionics system checkout and monitoring
in a flight test environment N75-10920

Airborne testing of advanced multisensor aircraft
N75-10921

AXIAL COMPRESSION LOADS
Practical application of the Howard-Czencow method
- Calculation of bent and axially compressed
beams. II A75-11375

AXIAL FLOW
Axial flow past a cylinder with suction A75-10140

AXIAL FLOW TURBINES
Small turbine engine technology
[AIAA PAPER 74-1184] A75-10333

AXISYMMETRIC FLOW
Two dimensional transonic two-phase flow in
axisymmetric nozzles A75-10275
[AIAA PAPER 74-1088]
A difference method for axisymmetric supersonic
flow in rotating annular cascades with local
subsonic regions A75-11045

B

B-1 AIRCRAFT
Inlet development for the B-1 strategic bomber
[AIAA PAPER 74-1064] A75-10258
B-1 forward radome A75-10866
B-1 forward radome fabrication A75-10881

BACKGROUND NOISE
Resistance of radar systems against interference
N75-11797

BALL BEARINGS
HLH/ATC engine shaft support bearing development
program [AD-784593] N75-10097

BARs
Number of bars and torque of squirrel cage rotors
--- for an asynchronous motor
[RAE-LIB-TRANS-1781] N75-11154

BEAMS (SUPPORTS)
Practical application of the Howard-Czencow method
- Calculation of bent and axially compressed
beams. II A75-11375

BENDING MOMENTS
Practical application of the Howard-Czencow method
- Calculation of bent and axially compressed
beams. II A75-11375

BINOCULARS
A technique for displaying flight information in
the field of view of binoculars for use by the
pilots of radio controlled models
[NASA-TM-X-72015] N75-10786

BO-105 HELICOPTER
MBB BO 105. II - Concept and worldwide use ---
helicopter design A75-12525

BODY-WING AND TAIL CONFIGURATIONS
Short SD3-30 --- twin turboprop commuter aircraft
with wide body design A75-12420

BODY-WING CONFIGURATIONS
Investigations involving a 'dynamically similar'
component model of the VFW 614 - Experimental
determination of the fundamental oscillation
parameters A75-11673

BOEING 727 AIRCRAFT
Fleet retrofit report
[NASA-CR-137586] N75-10941

BOEING 747 AIRCRAFT
ATC implications of the 747 SP A75-11092
Shuttle orbiter flight test plan evolves A75-12720

BOOSTER ROCKET ENGINES
Expendable solid propellant boost motors for small
target aircraft A75-10292
[AIAA PAPER 74-1125]

BORON
Boron/aluminum for space applications A75-13048

BOUNDARY LAYER CONTROL
The application of boundary layer suction to
suppress strong shock-induced separation in
supersonic inlets A75-10257
[AIAA PAPER 74-1063]
YC-14 system for leading edge boundary layer control
[AIAA PAPER 74-1278] A75-11115
Experimental study of spanwise air jet influence
on wing aerodynamic characteristics A75-12096
Ground effect for V/STOL aircraft configurations
and its simulation in the wind tunnel. Part 3:
The tangentially blown ground as an alternative
to a moving ground: Application to the
NASA-Ames 40 by 80-foot wind tunnel
[NASA-CR-114497] N75-10005

BOUNDARY LAYER FLOW
Turbulent mean velocity measurements on a rotating
cone A75-10043
A conceptual approach to applying singular
perturbation methods to variational problems ---
in optimal control A75-11895

BOUNDARY LAYER SEPARATION
The application of boundary layer suction to
suppress strong shock-induced separation in
supersonic inlets A75-10257
[AIAA PAPER 74-1063]
An analytical procedure for the calculation of
attached and separated subsonic diffuser flows
[AIAA PAPER 74-1173] A75-10323

BOUNDARY VALUE PROBLEMS
Low-frequency three-dimensional profile vibrations
in transonic gas flow A75-13132

BUBBLES
Methods of visualizing the leading edge separation
bubble and analysis of the results N75-10013

BUFFETING
Critical review of methods to predict the buffet
capability of aircraft
[AGARD-R-623] N75-10053
Transonic buffet behavior of Northrop P-5A aircraft
[NASA-CR-140939] N75-10054
The prediction of structural response to buffet
flow: A state-of-the-art review
[NASA-TM-X-72627] N75-11372

C

CALCULUS OF VARIATIONS
Variational-difference method of studying the
stressed state of the rim of the turbine disk in
a T-shaped tail joint A75-11235

CANARD CONFIGURATIONS
Some problems of the canard configuration. I
A75-12473

CASCADE FLOW
A difference method for axisymmetric supersonic
flow in rotating annular cascades with local
subsonic regions A75-11045
Applications of similarity laws in the case of
turbomachines A75-11674

CAST ALLOYS
Development of high strength cast superalloys with
hot corrosion resistance A75-13039

CENTER OF GRAVITY
Experimental determination of airplane mass and
inertial characteristics
[NASA-TR-R-433] N75-10062

CENTRIFUGAL COMPRESSORS
Small turbine engine technology
[AIAA PAPER 74-1184] A75-10333
High-performance centrifugal compressors A75-11739

CERTIFICATION
FAA Advisory Circular 00-41 Quality System
Certification Program A75-10675

CH-47 HELICOPTER

Model 301 HLH/ATC (Heavy Lift Helicopter/Advanced Technology Component) transmission noise reduction program [AD-784132] N75-10063

Technology development report: Results of static electricity discharge system tests (active and passive) heavy lift helicopter [AD-784130] N75-10082

CH-54 HELICOPTER
Executive summary report: Command statistics and evidenced problems --- for HC-54 A helicopter [AD-782990] N75-10939

CIVIL AVIATION
Proposed international air shuttle, 1975 [GPO-31-527] N75-10034
Total energy use for commercial aviation in the US [ORNL-NSF-EP-68] N75-10039
General aviation programs [GPO-41-153] N75-10903

CLIMBING FLIGHT
Optimum rate of climb for high performance aircraft [AD-784112] N75-10076

COCKPIT SIMULATORS
High-performance hydraulic system powers aircraft simulator A75-10426

COCKPITS
High acceleration cockpits for advanced fighter aircraft. Volume 1: Program summary --- human factors engineering for optimal design [AD-783600] N75-10064
High acceleration cockpits for advanced fighter aircraft. Volume 2: Crew station design/integration --- control and display devices [AD-783601] N75-10065
High acceleration cockpits for advanced fighter aircraft. Volume 3: Test plan --- static tests and mission profiles [AD-783602] N75-10066
High acceleration cockpits for advanced fighter aircraft. Volume 4: Test results [AD-783603] N75-10067

COHERENT RADAR
Aircraft-velocity measurement through radar-altimeter echo with noncoherent detection [SLA-74-112] N75-10290

COLD WEATHER TESTS
US Army helicopter icing tests N75-10932

COMBAT
YF-16 could advance air combat tactics A75-10017

COMBINED STRESS
Practical application of the Howard-Czencow method - Calculation of bent and axially compressed beams. II A75-11375

COMBUSTION EFFICIENCY
Studies of slurry fueled propulsion systems [AD-784362] N75-11114

COMBUSTION STABILITY
Flow immediately behind a step in a supersonic combustor [AIAA PAPER 74-1161] A75-10317

COMMERCIAL AIRCRAFT
The use of hydrogen in commercial aircraft - An assessment A75-10542
Electronic propulsion controls for commercial aircraft [AIAA PAPER 74-1065] A75-11280
Next generation transports will emphasize fuel savings A75-11426
A methodology for determining the flight system mix of an air transfer route structure --- modeling for aircraft operation profitability N75-10033
The attainable goal in airline safety N75-10035

COMPONENT RELIABILITY
A new look at qualification of aircraft equipment A75-12122

COMPOSITE MATERIALS
Elastic pitch beam tail rotor operational suitability investigation [AD-784595] N75-10069

COMPRESSIBILITY EFFECTS

Critical review of methods to predict the buffet capability of aircraft [AGARD-R-623] N75-10053

COMPRESSIBLE FLOW
A method of obtaining sub-critical compressible velocities for two-dimensional aerofoils from an exact inviscid incompressible solution A75-10189
A calculation method for the turbulent boundary layer on an infinite yawed wing in compressible, adiabatic flow [ARC-CP-1268] N75-10024

COMPRESSOR BLADES
Effect of erosive wear on aircraft gas turbine engine axial compressor cantilever blade endurance A75-12106

COMPRESSOR EFFICIENCY
High-performance centrifugal compressors A75-11739

COMPRESSOR ROTORS
Transonic compressor technology advancements N75-11199

COMPRESSORS
Single-stage experimental evaluation of tandem-airfoil rotor and stator blading for compressors, part 8 [NASA-CR-134713] N75-10947

COMPUTER PROGRAMS
Rapid calculation of propulsion system installation corrections --- for jet engines [AIAA PAPER 74-1174] A75-10324
A computer program for aircraft thrust ejector analyses [AIAA PAPER 74-1191] A75-10339
Radio frequency heating of radomes in an aerodynamic environment A75-10876

COMPUTER TECHNIQUES
A computer automated ultrasonic inspection system for aircraft forgings A75-12933

COMPUTERIZED DESIGN
Automated structural design with aeroelastic constraints - A review and assessment of the state of the art A75-11624
On computer-aided design of aerospace vehicles A75-11626

COMPUTERIZED SIMULATION
A response criterion for aircraft with fly-by-wire control systems A75-10018
The development of an accurate aerodynamic simulation model for the SAM-D missile with a relatively small computer storage requirement A75-10414
A wind energy conversion system based on the tracked-vehicle airfoil concept A75-10518
Real-time simulation of the TF30-P-3 turbofan engine using a hybrid computer [NASA-TN-X-3106] N75-10095

CONCORDE AIRCRAFT
The 1973 program of measurement of the minor constituents of the stratosphere using the Concorde 001 A75-11720

CONFERENCES
State of radome technology - 1974; Proceedings of the Twelfth Symposium on Electromagnetic Windows, Georgia Institute of Technology, Atlanta, Ga., June 12-14, 1974 A75-10851
Stress and vibration analysis with the aid of models; Meeting, Stuttgart, West Germany, October 4, 5, 1973, Reports A75-11672
Materials on the move; Proceedings of the Sixth National Technical Conference, Dayton, Ohio, October 8-10, 1974 A75-13028
Low cycle high temperature fatigue --- in aircraft jet engines: conference proceedings [AGARD-CP-155] N75-10487
Advancements in flight test engineering [LC-74-136-52] N75-10910

SUBJECT INDEX

DETONATION

Agenda and abstracts 1974 APOSR contractors meeting on Unconfined Detonation and Fuel-Air Explosion Related Research [AD-783253] N75-11117

CONFORMAL MAPPING
Generation of aerodynamic profiles and establishing the circulation around a wing by deformation of the wing A75-12638

CONGRESSIONAL REPORTS
Proposed international air shuttle, 1975 [GPO-31-527] N75-10034
General aviation programs [GPO-41-153] N75-10903

CONICAL FLOW
Turbulent mean velocity measurements on a rotating cone A75-10043

CONSTRUCTION MATERIALS
Materials on the move; Proceedings of the Sixth National Technical Conference, Dayton, Ohio, October 8-10, 1974 A75-13028
Polycarbonate aircraft transparencies A75-13041

CONTROL CONFIGURED VEHICLES
Fly-by-wire is here --- fighter aircraft flight control A75-12825

CONTROL SIMULATION
A response criterion for aircraft with fly-by-wire control systems A75-10018
Flight fidelity testing of US Navy operational flight trainers N75-10915

CONTROL STABILITY
Application of methods of abstract algebra to the synthesis of an automatic system for controlling the longitudinal motion of an aircraft A75-11121

CONTROL SURFACES
Analysis of multihinge tailplane with account for control surface deflection A75-12088
Fly-by-wire is here --- fighter aircraft flight control A75-12825
Performance improvement through control configured vehicle concept --- active control systems for aircraft life augmentation [NASA-TT-P-15998] N75-10059
The CCV concept and specifications [NASA-TT-P-15997] N75-10060

CONTROL THEORY
Optimal control theory investigation of propotor/wing response to vertical gust [NASA-TM-X-62384] N75-10057

CONVERGENT-DIVERGENT NOZZLES
F-14A installed nozzle performance [AIAA PAPER 74-1099] A75-10282

CORROSION RESISTANCE
Development of high strength cast superalloys with hot corrosion resistance A75-13039
Improved primer coating systems for the transportation industries A75-13043

COST ANALYSIS
Rationale for cost-weight analysis --- in airframe design [AIAA PAPER 74-961] A75-13069

COST EFFECTIVENESS
Mini-RPV's for cheap and no risk air power A75-10623
A policy study of subsidized air service [AIAA PAPER 74-1274] A75-11111
An inexpensive jet engine, dream or reality --- for remotely piloted vehicles A75-11724
A new look at qualification of aircraft equipment A75-12122
Structural advances in helicopter rotor blade technology A75-13045
A methodology for determining the flight system mix of an air transfer route structure --- modeling for aircraft operation profitability N75-10033

COST REDUCTION
The LTS 101 600 SHP engine [AIAA PAPER 74-1187] A75-11300
Next generation transports will emphasize fuel savings A75-11426

CRACK PROPAGATION
From creaking cracks to breaking beams - A review of acoustic emission for aircraft structure A75-13035

CREEP RUPTURE STRENGTH
Development of high strength cast superalloys with hot corrosion resistance A75-13039

CUMULATIVE DAMAGE
A case study of ultra high rate of wear experienced in a gear tooth flank [ASLE PREPRINT 74LC-6B-2] A75-12188

CYCLIC LOADS
Low cycle high temperature fatigue --- in aircraft jet engines: conference proceedings [AGARD-CP-155] N75-10487
Precision in LCHTF testing --- of aircraft jet engines N75-10490
The effect of cycle parameters on high temperature low cycle fatigue --- in aircraft jet engines N75-10491
Design procedures for elevated temperature low-cycle fatigue --- as applied to aircraft jet engines N75-10494

CYLINDRICAL BODIES
Axial flow past a cylinder with suction A75-10140

D

DAMPING
Pitch damping of helicopter rotor with nonuniform inflow A75-11094

DAMPING TESTS
A study of the damping characteristics on models of supersonic air lines at supersonic speeds [AD-784259] N75-10077

DATA ACQUISITION
A Saab-Scania developed method for obtaining stability derivatives from flight tests N75-10925

DATA PROCESSING
A Saab-Scania developed method for obtaining stability derivatives from flight tests N75-10925

DATA SYSTEMS
Aids - Expectations past, present and future --- Airborne Integrated Data System [AIAA PAPER 74-1067] A75-10260

DE HAVILLAND AIRCRAFT
Developing STOL operational criteria N75-10911

DEFLECTION
Analysis of multihinge tailplane with account for control surface deflection A75-12088

DEFLECTORS
V/STOL deflector concepts [AIAA PAPER 74-1168] A75-10319
Exhaust nozzle deflector systems for V/STOL fighter aircraft [AIAA PAPER 74-1169] A75-10320

DELTA WINGS
Low-speed wing-tunnel measurements of the lift, drag and pitching moment of a series of cropped delta wings [ARC-R/N-3744] N75-10030

DEMAND (ECONOMICS)
A methodology for determining the flight system mix of an air transfer route structure --- modeling for aircraft operation profitability N75-10033

DESCENT TRAJECTORIES
High sink-rate landing testing of Navy aircraft N75-10924

DETONATION
Agenda and abstracts 1974 APOSR contractors meeting on Unconfined Detonation and Fuel-Air Explosion Related Research [AD-783253] N75-11117

DIELECTRICS

DIELECTRICS

- Anisotropic dielectric panel analysis --- for radome materials A75-10859

DIFFUSERS

- An analytical procedure for the calculation of attached and separated subsonic diffuser flows [AIAA PAPER 74-1173] A75-10323

DIGITAL COMPUTERS

- Automated avionics system checkout and monitoring in a flight test environment N75-10920

DIGITAL SYSTEMS

- The digital electronic propulsion control system - Problems and payoffs [AIAA PAPER 74-1068] A75-10261
A conceptual definition study for a digital avionics information system (approach 2), volume 1 [AD-780581/5] N75-10071
A conceptual definition study for a digital avionics information system (approach 2). Volume 2: Appendixes A thru D [AD-780582/3] N75-10072

DIGITAL TECHNIQUES

- On computer-aided design of aerospace vehicles A75-11626

DISPLAY DEVICES

- A study on aircraft map display location and orientation A75-12725
High acceleration cockpits for advanced fighter aircraft. Volume 2: Crew station design/integration --- control and display devices [AD-783601] N75-10065
A conceptual definition study for a digital avionics information system (approach 2), volume 1 [AD-780581/5] N75-10071
A conceptual definition study for a digital avionics information system (approach 2). Volume 2: Appendixes A thru D [AD-780582/3] N75-10072
A technique for displaying flight information in the field of view of binoculars for use by the pilots of radio controlled models [NASA-TM-X-72015] N75-10786
Integrated avionics: Controls and displays for helicopter IFR operation N75-10917
Airborne testing of advanced multisensor aircraft N75-10921
A new jet engine thrust measuring system: An advancement in flight test engineering N75-10922

DIVERTERS

- Engine flow diverter system for the XFV-12A prototype aircraft [AIAA PAPER 74-1194] A75-10341

DOPPLER RADAR

- Doppler radar boast design innovations --- for aircraft A75-10625

DOUGLAS AIRCRAFT

- Operating experiences of retardant bombers during firefighting operations [NASA-TM-X-72622] N75-10934

DOWNWASH

- Measurement of model helicopter rotor flow velocities with a laser Doppler velocimeter A75-10839

DRAG

- The external drag of fuselage side intakes: Rectangular intakes with compression surfaces vertical [ARC-CP-1269] N75-10025
Results of a series of wind tunnel tests on the victor B.Mk.2 aircraft and a comparison with drag estimates and full scale flight data [ARC-CP-1283] N75-10026

DRAG MEASUREMENT

- A test technique for inlet/aircraft drag evaluation [AIAA PAPER 74-1145] A75-10306

DRONE AIRCRAFT

- Drone/RPV systems --- Remotely Piloted Vehicle as weapon system A75-10186

DUCTED FLOW

- An analytical procedure for the calculation of attached and separated subsonic diffuser flows [AIAA PAPER 74-1173] A75-10323

SUBJECT INDEX

DYNAMIC CHARACTERISTICS

- Determination of the dynamic characteristics of a structure from a vibration test performed with only one excitation point --- exemplified for aircraft structures N75-10371

DYNAMIC CONTROL

- Stabilization of the longitudinal motion of a flight vehicle in the presence of a delay in the control forces A75-11653

DYNAMIC RESPONSE

- Investigations involving a 'dynamically similar' component model of the VFW 614 - Experimental determination of the fundamental oscillation parameters A75-11673

- Applications of similarity laws in the case of turbomachines A75-11674

- A study of stabilization techniques for small, fixed-wing, remotely piloted aircraft [AD-784109] N75-10079

DYNAMIC STABILITY

- Some problems of the canard configuration. I A75-12473

DYNAMIC STRUCTURAL ANALYSIS

- Determination of the dynamic characteristics of a structure from a vibration test performed with only one excitation point --- exemplified for aircraft structures N75-10371

- The prediction of structural response to buffet flow: A state-of-the-art review [NASA-TM-X-72627] N75-11372

E

ECONOMIC ANALYSIS

- Some factors affecting the use of lighter than air systems --- economic and performance estimates for dirigibles and semi-buoyant hybrid vehicles [NASA-TM-X-62374] N75-10004

ECONOMIC FACTORS

- Reliability and maintainability of aircraft jet engines. II A75-12125

EJECTORS

- An analytic description of hypermixing and test of an improved nozzle [AIAA PAPER 74-1190] A75-10338
A computer program for aircraft thrust ejector analyses [AIAA PAPER 74-1191] A75-10339
Ejector thrust augmentation for STOL aircraft applications [AIAA PAPER 74-1192] A75-10340

ELASTIC BODIES

- An elastic flight vehicle as an automatic control plant --- Russian book A75-12329

ELASTIC DEFORMATION

- Variational-difference method of studying the stressed state of the rim of the turbine disk in a T-shaped tail joint A75-11235

- Calculation of helicopter main rotor blade deformation with account for control flexibility A75-12087

- Generation of aerodynamic profiles and establishing the circulation around a wing by deformation of the wing A75-12638

ELASTOMERS

- Endurance testing of an LM-726-4 elastomeric pitch change bearing [AD-784140] N75-10074

ELECTRICAL GROUNDING

- Technology development report: Results of static electricity discharge system tests (active and passive) heavy lift helicopter [AD-784130] N75-10082

ELECTRO-OPTICS

- Head-up display optics --- application to weapon aiming systems in military aircraft N75-10780

- Airborne testing of advanced multisensor aircraft N75-10921

ELECTROMAGNETIC COMPATIBILITY

Electromagnetic compatibility assurance tests for
airborne systems controls in an RF-polluted
environment
[AIAA PAPER 74-1096] A75-10279
EM window thermal barriers --- on supersonic
aircraft A75-10857

ELECTRONIC CONTROL

The digital electronic propulsion control system -
Problems and payoffs
[AIAA PAPER 74-1068] A75-10261
Electronic propulsion controls for commercial
aircraft [AIAA PAPER 74-1065] A75-11280

ELECTRONIC COUNTERMEASURES

T and E guidelines for airborne ECM systems
[AD-784574] N75-10332

ELECTRONIC EQUIPMENT TESTS

Electromagnetic compatibility assurance tests for
airborne systems controls in an RF-polluted
environment
[AIAA PAPER 74-1096] A75-10279

ELEVATORS (CONTROL SURFACES)

Stability limits for downsprings --- on light
aircraft A75-12618

ENERGY CONSUMPTION

Total energy use for commercial aviation in the US
[ORNL-NSF-EP-68] N75-10039

ENERGY CONVERSION EFFICIENCY

A wind energy conversion system based on the
tracked-vehicle airfoil concept A75-10518

ENERGY POLICY

Fuel outlook dictating technical transport research
A75-11427

ENGINE CONTROL

Powerplant energy management --- transport
aircraft engine thrust control
[AIAA PAPER 74-1066] A75-10259
The digital electronic propulsion control system -
Problems and payoffs
[AIAA PAPER 74-1068] A75-10261
V/STOL deflector concepts
[AIAA PAPER 74-1168] A75-10319
A critique of the F-14A air inlet control system -
From development to production status
[AIAA PAPER 74-1060] A75-11278
Electronic propulsion controls for commercial
aircraft [AIAA PAPER 74-1065] A75-11280

ENGINE DESIGN

The development program for the F-15 inlet
[AIAA PAPER 74-1061] A75-10256
Small flying engines are different --- aircraft
gas turbine design
[AIAA PAPER 74-1185] A75-10334
The Detroit Diesel Allison Model 250-C28
turbohaft engine
[AIAA PAPER 74-1186] A75-10335
Pretting in aircraft turbine engines
A75-10925
YP-16 inlet design and performance
[AIAA PAPER 74-1062] A75-11279
Electronic propulsion controls for commercial
aircraft [AIAA PAPER 74-1065] A75-11280
The LTS 101 600 SHP engine
[AIAA PAPER 74-1187] A75-11300
Viper turbojet engines. II --- design and
applications A75-11371
The American STAGG gas generator program
A75-11721
An inexpensive jet engine, dream or reality ---
for remotely piloted vehicles A75-11724
Teledyne aims at low-cost engines
A75-12722
HLH/ATC engine shaft support bearing development
program
[AD-784593] N75-10097
Design procedures for elevated temperature
low-cycle fatigue --- as applied to aircraft jet
engines N75-10494
Transonic compressor technology advancements
N75-11199

ENGINE INLETS

The development program for the F-15 inlet
[AIAA PAPER 74-1061] A75-10256
Inlet development for the B-1 strategic bomber
[AIAA PAPER 74-1064] A75-10258
Turbofan noise reduction using a near sonic inlet
[AIAA PAPER 74-1098] A75-10281
A test technique for inlet/aircraft drag evaluation
[AIAA PAPER 74-1145] A75-10306
Variable geometry for supersonic mixed-compression
inlets
[AIAA PAPER 74-1172] A75-10322
Statistical averages of subsonic inlet distortion
[AIAA PAPER 74-1197] A75-10342
Development and experimental verification of a
technique to test full-scale inlet/engine
systems at maneuvering conditions
[AIAA PAPER 74-1199] A75-10344
A critique of the F-14A air inlet control system -
From development to production status
[AIAA PAPER 74-1060] A75-11278
YP-16 inlet design and performance
[AIAA PAPER 74-1062] A75-11279
Flight-test techniques for obtaining valid
comparisons of wind-tunnel and flight results
from tests on a YP-12 mixed-compression inlet
[AIAA PAPER 74-1195] A75-11301

ENGINE MONITORING INSTRUMENTS

Aids - Expectations past, present and future ---
Airborne Integrated Data System
[AIAA PAPER 74-1067] A75-10260
A test cell engine diagnostic system - From
research to reality
[AIAA PAPER 74-1207] A75-10349
Reliability and maintainability of aircraft jet
engines. II A75-12125

ENGINE NOISE

Isolated rotor noise due to inlet distortion or
turbulence
[NASA-CR-2479] N75-10094
Effective data monitoring during airplane flyover
noise tests N75-10928
Noise of model target type thrust reversers for
engine-over-the-wing applications
[NASA-TN-X-71621] N75-10948

ENGINE TESTS

Engine flow diverter system for the XFPV-12A
prototype aircraft
[AIAA PAPER 74-1194] A75-10341
A test cell engine diagnostic system - From
research to reality
[AIAA PAPER 74-1207] A75-10349
Improved reliability of turbine engines through
common sense maintenance A75-11087
F-15 flight test experience with the F100-PW-100
engine
[AIAA PAPER 74-1162] A75-11297
Optimization of automated static tests of gas
turbine engines --- Russian book A75-12332
Scale model testing of the jet noise
characteristics of the JT8D refan engine nozzle
system
[NASA-CR-134618] N75-10091
Precision in LCHTF testing --- of aircraft jet
engines N75-10490

ENVIRONMENT EFFECTS

Helicopter - People and places /14th Cierva
Memorial Lecture/ --- emphasizing safety factors
and passenger travel A75-10187

ENVIRONMENT POLLUTION

Electromagnetic compatibility assurance tests for
airborne systems controls in an RF-polluted
environment
[AIAA PAPER 74-1096] A75-10279

ENVIRONMENTAL TESTS

The 1973 program of measurement of the minor
constituents of the stratosphere using the
Concorde 001 A75-11720

EPOXY RESINS

Improved primer coating systems for the
transportation industries A75-13043

EQUIPMENT SPECIFICATIONS

SUBJECT INDEX

Applications of graphite and aramid composites on the YF-17 prototype fighter A75-13047

EQUIPMENT SPECIFICATIONS
FAA Advisory Circular 00-41 Quality System Certification Program A75-10675

A new look at qualification of aircraft equipment A75-12122

ERROR CORRECTING DEVICES
Influence of inherent carrier motion on a frequency selection system A75-12060

ESCAPE SYSTEMS
The rotor systems research aircraft - A flying wind tunnel [AIAA PAPER 74-1277] A75-11114

ESTIMATING
Estimation of the characteristics of various flare profiles [ESRO-TT-89] N75-10031

EXCITATION
Determination of the dynamic characteristics of a structure from a vibration test performed with only one excitation point --- exemplified for aircraft structures N75-10371

EXHAUST NOZZLES
F-14A installed nozzle performance [AIAA PAPER 74-1099] A75-10282
Exhaust nozzle deflector systems for V/STOL fighter aircraft [AIAA PAPER 74-1169] A75-10320
Engine flow diverter system for the XFV-12A prototype aircraft [AIAA PAPER 74-1194] A75-10341
Installation benefits of the single-engine exhaust nozzle on the YF-16 [AIAA PAPER 74-1101] A75-12571

EXHAUST SYSTEMS
A flow field model for, and some studies on the drag of, an engine exhaust system at transonic flight speeds [AIAA PAPER 74-1175] A75-10325

EXPLOSIONS
Agenda and abstracts 1974 AFOSR contractors meeting on Unconfined Detonation and Fuel-Air Explosion Related Research [AD-783253] N75-11117

EXPLOSIVE DEVICES
Development of explosively driven MHD generator for short pulse aircraft high power. Part 1: Analytical studies. Part 2: Experimental studies. Part 3: Design studies [AD-784903] N75-11764

EXTERNALLY BLOWN FLAPS
Comparison of the acoustic characteristics of large-scale models of several propulsive-lift concepts [AIAA PAPER 74-1094] A75-10278
Comment on 'Investigation of multi-element airfoils with external flow jet flap' by P. Mavriplis A75-11084

The externally-blown jet flap - A powered-lift concept for STOL A75-11085

Analysis of a flare-director concept for an externally blown flap STOL aircraft [NASA-TN-D-7760] N75-10061

F

F-4 AIRCRAFT
High acceleration cockpits for advanced fighter aircraft. Volume 1: Program summary --- human factors engineering for optimal design [AD-783600] N75-10064

F-5 AIRCRAFT
Transonic buffet behavior of Northrop F-5A aircraft [NASA-CR-140939] N75-10054

F-8 AIRCRAFT
Extraction from flight data of lateral aerodynamic coefficients for F-8 aircraft with supercritical wing [NASA-TN-D-7749] N75-10006

F-14 AIRCRAFT
F-14A installed nozzle performance [AIAA PAPER 74-1099] A75-10282

A critique of the F-14A air inlet control system - From development to production status [AIAA PAPER 74-1060] A75-11278

F-15 AIRCRAFT
The development program for the F-15 inlet [AIAA PAPER 74-1061] A75-10256
F-15 nozzle/afterbody integration [AIAA PAPER 74-1100] A75-10283
F-15 flight test experience with the F100-PW-100 engine [AIAA PAPER 74-1162] A75-11297
NASA Flight Research Center scale F-15 remotely piloted research vehicle program N75-10912
Flight testing the F-15/AIM-7F weapon delivery mode N75-10918

FAILURE ANALYSIS
Failure analyses of aircraft accidents. II A75-12726

FAILURE MODES
Development of accelerated life testing techniques for general failure modes of aircraft hardware [AD-784188] N75-10073

FATIGUE LIFE
Effect of erosive wear on aircraft gas turbine engine axial compressor cantilever blade endurance A75-12106
Lifetime prediction methods for elevated temperature fatigue --- in aircraft jet engines N75-10493

FATIGUE TESTS
From creaking cracks to breaking beams - A review of acoustic emission for aircraft structure A75-13035

FIGHTER AIRCRAFT
Exhaust nozzle deflector systems for V/STOL fighter aircraft [AIAA PAPER 74-1169] A75-10320
Test and evaluation of a fighter aircraft in-flight thrust reverser [AIAA PAPER 74-1170] A75-10321
Flight-test techniques for obtaining valid comparisons of wind-tunnel and flight results from tests on a YF-12 mixed-compression inlet [AIAA PAPER 74-1195] A75-11301
Fly-by-wire is here --- fighter aircraft flight control A75-12825
Applications of graphite and aramid composites on the YF-17 prototype fighter A75-13047

FILAMENT WINDING
Structural advances in helicopter rotor blade technology A75-13045

FINITE DIFFERENCE THEORY
A difference method for axisymmetric supersonic flow in rotating annular cascades with local subsonic regions A75-11045
Variational-difference method of studying the stressed state of the rim of the turbine disk in a T-shaped tail joint A75-11235

FINNED BODIES
Fundamental geometric and aerodynamic characteristics of aircraft and finned rockets --- Russian book A75-11577

FIRE EXTINGUISHERS
Evaluation of auxiliary agents and systems for aircraft ground fire suppression, phase 2 [AD-784924] N75-10957

FIRE FIGHTING
Operating experiences of retardant bombers during firefighting operations [NASA-TN-X-72622] N75-10934

FIRE PREVENTION
MIL-H-83282, fire resistant hydraulic fluid --- for military aircraft A75-13052
Fire protection of large Air Force hangars [AD-784869] N75-10961

FLAPPING HINGES
Pitch damping of helicopter rotor with nonuniform inflow A75-11094

SUBJECT INDEX

FLIGHT TESTS

FLIGHT CHARACTERISTICS

Loadings and flight limitations of the sailplane having the speed flap. I

A75-10721

The SA. 360 'Dauphin' - Definition and development --- helicopter design

A75-11722

Calculation of helicopter main rotor blade deformation with account for control flexibility

A75-12087

An elastic flight vehicle as an automatic control plant --- Russian book

A75-12329

Critical review of methods to predict the buffet capability of aircraft

[AGARD-R-623] N75-10053

Optimum rate of climb for high performance aircraft

[AD-784112] N75-10076

Yaw axis stability augmentation system flight test report --- flight tests of H-58 helicopter

[AD-784134] N75-10083

Effects of ground-based aircraft simulator motion conditions upon prediction of pilot proficiency, part 1

[AD-783256] N75-10112

Operating experiences of retardant bombers during firefighting operations

[NASA-TM-X-72622] N75-10934

FLIGHT CONDITIONS

Atmospheric ozone and its influence on the operation of supersonic transport

A75-11639

FLIGHT CONTROL

A response criterion for aircraft with fly-by-wire control systems

A75-10018

Stabilization of the longitudinal motion of a flight vehicle in the presence of a delay in the control forces

A75-11653

Yaw axis stability augmentation system flight test report --- flight tests of H-58 helicopter

[AD-784134] N75-10083

The R and D simulator: A new T and E tool --- application of simulators for research and development of aircraft systems

N75-10914

Automated avionics system checkout and monitoring in a flight test environment

N75-10920

FLIGHT HAZARDS

Annual review of aircraft accident data: US General Aviation calendar year 1971

[NTSB-ARG-74-2] N75-10037

Monitoring the Movement of wake vortices at Kennedy and Stapleton Airports

N75-10929

FLIGHT INSTRUMENTS

Integrated avionics: Controls and displays for helicopter IFR operation

N75-10917

FLIGHT OPTIMIZATION

Certain problems of fuel consumption in air transport

A75-11372

FLIGHT PATHS

Estimation of the characteristics of various flare profiles

[ESRO-TT-89] N75-10031

Optimum rate of climb for high performance aircraft

[AD-784112] N75-10076

Yaw axis stability augmentation system flight test report --- flight tests of H-58 helicopter

[AD-784134] N75-10083

High sink-rate landing testing of Navy aircraft

N75-10924

FLIGHT PLANS

A methodology for determining the flight system mix of an air transfer route structure --- modeling for aircraft operation profitability

N75-10033

FLIGHT RECORDERS

Aids - Expectations past, present and future --- Airborne Integrated Data System

[AIAA PAPER 74-1067] A75-10260

Statistical analysis of general aviation VG-VGH data

[NASA-CR-132531] N75-10933

FLIGHT SAFETY

Influence of airplane structural elasticity on flight safety and comfort in turbulent atmosphere

A75-12098

US Army helicopter icing tests

N75-10932

FLIGHT SIMULATION

A response criterion for aircraft with fly-by-wire control systems

A75-10018

High-performance hydraulic system powers aircraft simulator

A75-10426

Development of Slip Cast Fused Silica radomes

A75-10870

FLIGHT SIMULATORS

The R and D simulator: A new T and E tool --- application of simulators for research and development of aircraft systems

N75-10914

Flight fidelity testing of US Navy operational flight trainers

N75-10915

Uses of a visual landing system in primary flight training

[AD-784888] N75-10960

FLIGHT TEST INSTRUMENTS

Advancements in flight test engineering

[LC-74-136-52] N75-10910

FLIGHT TEST VEHICLES

The rotor systems research aircraft - A flying wind tunnel

[AIAA PAPER 74-1277] A75-11114

Advancements in flight test engineering

[LC-74-136-52] N75-10910

FLIGHT TESTS

YF-16 could advance air combat tactics

A75-10017

Test and evaluation of a fighter aircraft in-flight thrust reverser

[AIAA PAPER 74-1170] A75-10321

P-15 flight test experience with the F100-PW-100 engine

[AIAA PAPER 74-1162] A75-11297

Recent flight experience with the F100 engine in the YF-16

[AIAA PAPER 74-1163] A75-11298

Flight-test techniques for obtaining valid comparisons of wind-tunnel and flight results from tests on a YF-12 mixed-compression inlet

[AIAA PAPER 74-1195] A75-11301

Kasprzyk's revelatory wing --- for gliders

A75-12474

Shuttle orbiter flight test plan evolves

A75-12720

Results of a series of wind tunnel tests on the victor B.Mk.2 aircraft and a comparison with drag estimates and full scale flight data

[ARC-CP-1283] N75-10026

Transonic buffet behavior of Northrop F-5A aircraft

[NASA-CR-140939] N75-10054

A technique for displaying flight information in the field of view of binoculars for use by the pilots of radio controlled models

[NASA-TM-X-72015] N75-10786

Advancements in flight test engineering

[LC-74-136-52] N75-10910

Developing STOL operational criteria

N75-10911

NASA Flight Research Center scale F-15 remotely piloted research vehicle program

N75-10912

Flight testing the F-15/AIM-7F weapon delivery mode

N75-10918

Automated avionics system checkout and monitoring in a flight test environment

N75-10920

Airborne testing of advanced multisensor aircraft

N75-10921

A new jet engine thrust measuring system: An advancement in flight test engineering

N75-10922

A Saab-Scania developed method for obtaining stability derivatives from flight tests

N75-10925

Application of the fast Fourier transform to ground vibration testing, and flight flutter testing

N75-10926

FLIGHT TRAINING

SUBJECT INDEX

Effective data monitoring during airplane flyover noise tests		Aerospace Research --- topics on airfoil profiles, flow visualization, ablative materials, microanalysis, and filter analysis	
Hot-wire anemometry for in-flight measurement of aircraft wake vortices	N75-10928	[ESRO-TT-90]	N75-10011
Results of full-scale vortex attenuation flight experiments	N75-10930	Application of the fast Fourier transform to ground vibration testing, and flight flutter testing	
US Army helicopter icing tests	N75-10931	A passive wingtip load alleviation system	N75-10926
A remotely augmented vehicle approach to flight testing RPV control systems	N75-10932	[NASA-CR-140758]	N75-10937
[NASA-TN-X-56029]	N75-10936	FLY BY WIRE CONTROL	
Fleet retrofit report	N75-10941	A response criterion for aircraft with fly-by-wire control systems	A75-10018
[NASA-CR-137586]		Fly-by-wire is here --- fighter aircraft flight control	A75-12825
FLIGHT TRAINING			
Uses of a visual landing system in primary flight training		FOREBODIES	
[AD-784888]	N75-10960	A parametric study of effect of forebody shape on flow angularity at Mach 8 --- for hypersonic aircraft	
FLOW DISTORTION		[NASA-TN-D-7768]	N75-10008
Statistical averages of subsonic inlet distortion	A75-10342	FORGING	
[AIAA PAPER 74-1197]		A computer automated ultrasonic inspection system for aircraft forgings	A75-12933
Two-stage fan. 2: Data and performance with redesigned second stage rotor uniform and distorted inlet flows	N75-10944		
[NASA-CR-134710]		FOURIER TRANSFORMATION	
FLOW DISTRIBUTION		Application of the fast Fourier transform to ground vibration testing, and flight flutter testing	N75-10926
Flow immediately behind a step in a supersonic combustor	A75-10317		
[AIAA PAPER 74-1161]		FRACTURE STRENGTH	
A flow field model for, and some studies on the drag of, an engine exhaust system at transonic flight speeds	A75-10325	Evaluating new aluminum forging alloys	A75-12729
[AIAA PAPER 74-1175]		Laminated metallic structure - Advanced applications	A75-13046
Generation of aerodynamic profiles and establishing the circulation around a wing by deformation of the wing	A75-12638		
A parametric study of effect of forebody shape on flow angularity at Mach 8 --- for hypersonic aircraft	N75-10008	FREE FALL	
[NASA-TN-D-7768]		Shuttle orbiter flight test plan evolves	A75-12720
FLOW EQUATIONS			
Two dimensional transonic two-phase flow in axisymmetric nozzles	A75-10275	FREQUENCY ASSIGNMENT	
[AIAA PAPER 74-1088]		Influence of inherent carrier motion on a frequency selection system	A75-12060
An extension of the 'parabolic method' to the calculation of transonic flows	A75-10837		
Analog simulation of the small perturbation equation applied to transonic flows --- and wall and cascade flows	N75-10370	PRETTING	
		Pretting in aircraft turbine engines	A75-10925
FLOW MEASUREMENT			
Applied aerodynamics --- Russian book on experimental methods, measurement and calculation techniques	A75-13026	PRETTING CORROSION	
Monitoring the Movement of wake vortices at Kennedy and Stapleton Airports	N75-10929	Failure analyses of aircraft accidents. II	A75-12726
Hot-wire anemometry for in-flight measurement of aircraft wake vortices	N75-10930		
		FUEL COMBUSTION	
FLOW STABILITY		Advanced supersonic technology concept study: Hydrogen fueled configuration	N75-10943
The stability of a trailing line vortex. II - Viscous theory	A75-10621	[NASA-CR-114718]	
Applications of similarity laws in the case of turbomachines	A75-11674	FUEL CONSUMPTION	
		Powerplant energy management --- transport aircraft engine thrust control	A75-10259
FLOW VISUALIZATION		[AIAA PAPER 74-1066]	
Aerospace Research --- topics on airfoil profiles, flow visualization, ablative materials, microanalysis, and filter analysis	N75-10011	The LTS 101 600 SHP engine	A75-11300
[ESRO-TT-90]		[AIAA PAPER 74-1187]	
Methods of visualizing the leading edge separation bubble and analysis of the results	N75-10013	Certain problems of fuel consumption in air transport	A75-11372
		Next generation transports will emphasize fuel savings	A75-11426
FLUTTER ANALYSIS		Fuel outlook dictating technical transport research	A75-11427
Automated structural design with aeroelastic constraints --- A review and assessment of the state of the art	A75-11624	Total energy use for commercial aviation in the US	N75-10039
Vibrational investigations on aircraft models in support of flutter calculations	A75-11676	[ORNL-NSF-EP-68]	
		FUEL INJECTION	
		Flow immediately behind a step in a supersonic combustor	A75-10317
		[AIAA PAPER 74-1161]	
		FUEL TANKS	
		Experimental hydraulic ram studies (FY 74)	N75-11230
		[AD-784736]	
		FUEL TESTS	
		The use of jet fuels in aviation --- Russian book	A75-13000
		FUEL-AIR RATIO	
		Agenda and abstracts 1974 AFOSR contractors meeting on Unconfined Detonation and Fuel-Air Explosion Related Research	N75-11117
		[AD-783253]	
		FUMES	
		Emission of smoke and fumes at temperatures up to 500 C	A75-10799

SUBJECT INDEX

HELICOPTER PERFORMANCE

FUSELAGES
 Boron/aluminum for space applications A75-13048

FV-12A AIRCRAFT
 Engine flow diverter system for the XFV-12A
 prototype aircraft
 [AIAA PAPER 74-1194] A75-10341

G

GAS DYNAMICS
 Low-frequency three-dimensional profile vibrations
 in transonic gas flow A75-13132

GAS FLOW
 Influence of swirling flow on heat transfer in
 nozzles A75-10204

Engine flow diverter system for the XFV-12A
 prototype aircraft
 [AIAA PAPER 74-1194] A75-10341

GAS GENERATORS
 The American STAGG gas generator program A75-11721

GAS TURBINE ENGINES
 Small turbine engine technology
 [AIAA PAPER 74-1184] A75-10333

Small flying engines are different --- aircraft
 gas turbine design A75-10334

[AIAA PAPER 74-1185] A75-10336

Sealing technology for aircraft gas turbine engines
 [AIAA PAPER 74-1188] A75-10336

High-performance centrifugal compressors A75-11739

Mainshaft seals for small gas turbine engines
 [ASLE PREPRINT 74LC-1C-2] A75-12197

Optimization of automated static tests of gas
 turbine engines --- Russian book A75-12332

GAS TURBINES
 Gas turbine engines - A state-of-the-art review A75-10840

Investigation and optimization of micro-oxidation
 techniques employed in gas turbine engine oil
 characterization
 [AD-784787] N75-11359

GEAR TEETH
 A case study of ultra high rate of wear
 experienced in a gear tooth flank
 [ASLE PREPRINT 74LC-6B-2] A75-12188

GENERAL AVIATION AIRCRAFT
 Effects of ground-based aircraft simulator motion
 conditions upon prediction of pilot proficiency,
 part 1
 [AD-783256] N75-10112

General aviation programs
 [GPO-41-153] N75-10903

Statistical analysis of general aviation VG-VGH data
 [NASA-CR-132531] N75-10933

GLIDE PATHS
 Automatic flying of curved approach paths: A
 computer and flight investigation
 [RAB-TR-73154] N75-10043

GLIDERS
 Loadings and flight limitations of the sailplane
 having the speed flap. I A75-10721

Kasprzyk's revelatory wing --- for gliders A75-12474

Selected problems concerning the strength of a
 bonded heavily loaded Dural structure A75-12475

GRAPHITE
 Structural advances in helicopter rotor blade
 technology A75-13045

Applications of graphite and aramid composites on
 the YF-17 prototype fighter A75-13047

GROUND EFFECT
 Prediction of ground effects for VTOL aircraft
 with twin lifting jets
 [AIAA PAPER 74-1167] A75-10318

Ground effect for V/STOL aircraft configurations
 and its simulation in the wind tunnel. Part 3:
 The tangentially blown ground as an alternative
 to a moving ground: Application to the
 NASA-Ames 40 by 80-foot wind tunnel
 [NASA-CR-114497] N75-10005

GUST LOADS
 A study of stabilization techniques for small,
 fixed-wing, remotely piloted aircraft
 [AD-784109] N75-10079

GYROSCOPES
 Effect of the rotation rate of the rotor on the
 angular rigidity of the elastic suspension of a
 Houve gyroscope N75-11241

H

H-53 HELICOPTER
 Investigation of the effects of blade structural
 design parameters on helicopter stall boundaries
 [AD-784594] N75-10075

HAIL
 Development of an armored T-28 aircraft for
 probing hailstorms A75-10638

HANDLEY PAGE AIRCRAFT
 Results of a series of wind tunnel tests on the
 victor B.Mk.2 aircraft and a comparison with
 drag estimates and full scale flight data
 [ARC-CP-1283] N75-10026

HANGARS
 Fire protection of large Air Force hangars
 [AD-784869] N75-10961

HEAD-UP DISPLAYS
 Head-up display optics --- application to weapon
 aiming systems in military aircraft N75-10780

HEAT RESISTANT ALLOYS
 Development of high strength cast superalloys with
 hot corrosion resistance A75-13039

HEAT TRANSFER
 Heat and mass transfer in engines of flight vehicles
 --- Russian book A75-10203

HEAT TRANSFER COEFFICIENTS
 Influence of swirling flow on heat transfer in
 nozzles A75-10204

HELICOPTER CONTROL
 Navigation in the use of helicopters offshore
 MBB BO 105. II - Concept and worldwide use ---
 helicopter design A75-12373

A75-12525

HELICOPTER DESIGN
 The SA. 360 'Dauphin' - Definition and development
 --- helicopter design A75-11722

A case study of ultra high rate of wear
 experienced in a gear tooth flank
 [ASLE PREPRINT 74LC-6B-2] A75-12188

Structural advances in helicopter rotor blade
 technology A75-13045

NASA-Langley helicopter tower instrumentation
 systems
 [NASA-CR-132522] N75-10106

Integrated avionics: Controls and displays for
 helicopter IFR operation N75-10917

HELICOPTER ENGINES
 The Detroit Diesel Allison Model 250-C28
 turboshaft engine
 [AIAA PAPER 74-1186] A75-10335

The LTS 101 600 SHP engine
 [AIAA PAPER 74-1187] A75-11300

Mainshaft seals for small gas turbine engines
 [ASLE PREPRINT 74LC-1C-2] A75-12197

HLH/ATC engine shaft support bearing development
 program
 [AD-784593] N75-10097

HELICOPTER PERFORMANCE
 Helicopter - People and places /14th Cierva
 Memorial Lecture/ --- emphasizing safety factors
 and passenger travel A75-10187

Measurement of model helicopter rotor flow
 velocities with a laser Doppler velocimeter A75-10839

Pitch damping of helicopter rotor with nonuniform
 inflow A75-11094

HELICOPTERS

SUBJECT INDEX

- The rotor systems research aircraft - A flying wind tunnel
[AIAA PAPER 74-1277] A75-11114
Calculation of helicopter main rotor blade deformation with account for control flexibility A75-12087
- MBB BO 105. II - Concept and worldwide use --- helicopter design A75-12525
- An exploratory flight investigation of helicopter sling-load placements using a closed-circuit television as a pilot aid
[NASA-TN-D-7776] N75-10009
- Yaw axis stability augmentation system flight test report --- flight tests of H-58 helicopter
[AD-784134] N75-10083
- ## HELICOPTERS
- Development and experimental verification of procedures to determine nonlinear load-deflection characteristics of helicopter substructures subjected to crash forces. Volume 1: Development of simplified analytical techniques to predict typical helicopter airframe crushing characteristics and the formulation of design procedures
[AD-784191] N75-10940
- ## HIGH STRENGTH ALLOYS
- Development of high strength cast superalloys with hot corrosion resistance A75-13039
- ## HIGH TEMPERATURE
- Low cycle high temperature fatigue --- in aircraft jet engines: conference proceedings
[AGARD-CP-155] N75-10487
- Precision in LCHTF testing --- of aircraft jet engines N75-10490
- The effect of cycle parameters on high temperature low cycle fatigue --- in aircraft jet engines N75-10491
- Lifetime prediction methods for elevated temperature fatigue --- in aircraft jet engines N75-10493
- Design procedures for elevated temperature low-cycle fatigue --- as applied to aircraft jet engines N75-10494
- ## HIGH TEMPERATURE TESTS
- Emission of smoke and fumes at temperatures up to 500 C A75-10799
- ## HORIZONTAL FLIGHT
- Evaluation of the accuracy of two helicopter rotor theories
[PFA-124] N75-10020
- ## HORN ANTENNAS
- A prototype four-horn cluster IPF antenna
[AD-784395] N75-10327
- ## HOT-WIRE ANEMOMETERS
- Hot-wire anemometry for in-flight measurement of aircraft wake vortices N75-10930
- ## HOVERING STABILITY
- Some calculations for air resonance of a helicopter with non-articulated rotor blades
[ARC-R/M-3743] N75-10029
- ## HUMAN FACTORS ENGINEERING
- High acceleration cockpits for advanced fighter aircraft. Volume 1: Program summary --- human factors engineering for optimal design
[AD-783600] N75-10064
- High acceleration cockpits for advanced fighter aircraft. Volume 2: Crew station design/integration --- control and display devices
[AD-783601] N75-10065
- High acceleration cockpits for advanced fighter aircraft. Volume 3: Test plan --- static tests and mission profiles
[AD-783602] N75-10066
- High acceleration cockpits for advanced fighter aircraft. Volume 4: Test results
[AD-783603] N75-10067
- ## HUMAN REACTIONS
- A survey of aircraft noise annoyance in an area of invariant noise to eliminate the effects on annoyance of varying noise exposure
[TT-7405] N75-10755
- ## HYBRID COMPUTERS
- Real-time simulation of the TF30-P-3 turbofan engine using a hybrid computer
[NASA-TN-X-3106] N75-10095
- ## HYDRAULIC EQUIPMENT
- High-performance hydraulic system powers aircraft simulator A75-10426
- Experimental hydraulic ram studies (FY 74)
[AD-784736] N75-11230
- ## HYDRAULIC FLUIDS
- MIL-H-83282, fire resistant hydraulic fluid --- for military aircraft A75-13052
- ## HYDRAULIC TEST TUNNELS
- Correlation for estimating vortex rotational velocity downstream dependence A75-12621
- ## HYDROCARBON COMBUSTION
- Flow immediately behind a step in a supersonic combustor
[AIAA PAPER 74-1161] A75-10317
- ## HYDROCARBON FUELS
- The use of jet fuels in aviation --- Russian book A75-13000
- ## HYDROGEN FUELS
- The use of hydrogen in commercial aircraft - An assessment A75-10542
- Advanced supersonic technology concept study: Hydrogen fueled configuration
[NASA-CR-114718] N75-10943
- ## HYDROPLANING
- Skid resistance tests in support of the F-4 rain tire program at the Air Force Flight Test Center
[AD-784801] N75-10958
- Evaluation of construction techniques for new antihydroplaning overlays
[AD-784870] N75-10959
- ## HYPERBOLIC FUNCTIONS
- Tabulated values of combinations of cyclic and hyperbolic functions N75-10052
- ## HYPERSONIC AIRCRAFT
- Performance limitation of a hypersonic ramjet engine due to reaction kinetics A75-11046
- A parametric study of effect of forebody shape on flow angularity at Mach 8 --- for hypersonic aircraft
[NASA-TN-D-7768] N75-10008
- ## ICE FORMATION
- US Army helicopter icing tests N75-10932
- ## IMPACT RESISTANCE
- Development and experimental verification of procedures to determine nonlinear load-deflection characteristics of helicopter substructures subjected to crash forces. Volume 1: Development of simplified analytical techniques to predict typical helicopter airframe crushing characteristics and the formulation of design procedures
[AD-784191] N75-10940
- ## IMPACT TESTS
- Elastic pitch beam tail rotor operational suitability investigation
[AD-784595] N75-10069
- ## IN-FLIGHT MONITORING
- Real-time measuring procedure and measuring equipment for recording the radiation patterns of aircraft antennas in flight
[ESRO-TT-74] N75-10292
- T and E guidelines for airborne ECM systems
[AD-784574] N75-10332
- ## INCLUSIONS
- Automated computerized ultrasonic rating system provides new level of design confidence A75-12931
- ## INCOMPRESSIBLE FLOW
- A viscous/potential flow interaction analysis method for multi-element infinite swept wings, volume 1
[NASA-CR-2476] N75-10358

INFINITE SPAN WINGS

A calculation method for the turbulent boundary layer on an infinite yawed wing in compressible, adiabatic flow
[ARC-CP-1268] N75-10024

A viscous/potential flow interaction analysis method for multi-element infinite swept wings, volume 1
[NASA-CR-2476] N75-10358

INFLATABLE STRUCTURES

LTA in the USA - Here's where it stands today --- lighter than air vehicles
[AIAA PAPER 74-1280] A75-11116

INFORMATION FLOW

The attainable goal in airline safety
N75-10035

INFORMATION SYSTEMS

A conceptual definition study for a digital avionics information system (approach 2), volume 1
[AD-780581/5] N75-10071

A conceptual definition study for a digital avionics information system (approach 2). Volume 2: Appendixes A thru D
[AD-780582/3] N75-10072

INLET FLOW

Statistical averages of subsonic inlet distortion
[AIAA PAPER 74-1197] A75-10342

The external drag of fuselage side intakes: Rectangular intakes with compression surfaces vertical
[ARC-CP-1269] N75-10025

Isolated rotor noise due to inlet distortion or turbulence
[NASA-CR-2479] N75-10094

Two-stage fan. 2: Data and performance with redesigned second stage rotor uniform and distorted inlet flows
[NASA-CR-134710] N75-10944

INSTRUMENT FLIGHT RULES

Integrated avionics: Controls and displays for helicopter IFR operation
N75-10917

INSTRUMENT LANDING SYSTEMS

Flight demonstration of the feasibility of a scanning beam microwave landing system
N75-10919

INTEGRAL EQUATIONS

Some remarks on the solution of the lifting line equation
A75-11095

INTERFERENCE DRAG

Interference of a sweptback wing and the fuselage at transonic speeds
[NASA-TT-F-15993] N75-10056

INTERNAL COMPRESSION INLETS

Variable geometry for supersonic mixed-compression inlets
[AIAA PAPER 74-1172] A75-10322

INVISCID FLOW

A method of obtaining sub-critical compressible velocities for two-dimensional aerofoils from an exact inviscid incompressible solution
A75-10189

ITERATIVE SOLUTION

An extension of the 'parabolic method' to the calculation of transonic flows
A75-10837

J**JET AIRCRAFT**

Optimum rate of climb for high performance aircraft
[AD-784112] N75-10076

Experimental hydraulic ram studies (FY 74)
[AD-784736] N75-11230

JET AIRCRAFT NOISE

Noise and atmospheric emissions - An airline view
A75-11083

Acoustics of the sonic boom --- Book
A75-13023

Fluid dynamic aspects of jet noise generation
[NASA-CR-140673] N75-10088

Scale model testing of the jet noise characteristics of the JT8D refan engine nozzle system
[NASA-CR-134618] N75-10091

A computing method for sound propagation through a nonuniform jet stream
[NASA-TM-X-71941] N75-10359

JET CONTROL

Optimum transient response characteristic of a VTOL aircraft with direct side force control --- jet control for optimization of VTOL aircraft flight characteristics
[DLR-FB-73-72] N75-10103

JET ENGINE FUELS

The use of jet fuels in aviation --- Russian book
A75-13000

A comparison of optimum JP and LH2 turbofan engines designed for two subsonic transport missions
[NASA-TM-X-71622] N75-10945

JET ENGINES

Reliability and maintainability of aircraft jet engines. II
A75-12125

Low cycle high temperature fatigue --- in aircraft jet engines: conference proceedings
[AGARD-CP-155] N75-10487

Precision in LCHTF testing --- of aircraft jet engines
N75-10490

The effect of cycle parameters on high temperature low cycle fatigue --- in aircraft jet engines
N75-10491

Lifetime prediction methods for elevated temperature fatigue --- in aircraft jet engines
N75-10493

Design procedures for elevated temperature low-cycle fatigue --- as applied to aircraft jet engines
N75-10494

A new jet engine thrust measuring system: An advancement in flight test engineering
N75-10922

JET FLAPS

Comparison of the acoustic characteristics of large-scale models of several propulsive-lift concepts
[AIAA PAPER 74-1094] A75-10278

Comment on 'Investigation of multi-element airfoils with external flow jet flap' by P. Mavriplis
A75-11084

The externally-blown jet flap - A powered-lift concept for STOL
A75-11085

JET LIFT

Prediction of ground effects for VTOL aircraft with twin lifting jets
[AIAA PAPER 74-1167] A75-10318

JET MIXING FLOW

Oscillating jet nozzles for V/STOL application
[AIAA PAPER 74-1189] A75-10337

An analytic description of hypermixing and test of an improved nozzle
[AIAA PAPER 74-1190] A75-10338

JP-4 JET FUEL

Lubricity of jet A-1 and JP-4 fuels --- as indicated by wear friction
[AD-784772] N75-11115

L**LAMINAR BOUNDARY LAYER**

Axial flow past a cylinder with suction
A75-10140

LAMINATES

Laminated metallic structure - Advanced applications
A75-13046

LANDING GEAR

Determination of the forces in the retractor of a three-dimensional landing gear mechanism
[AD-784257] N75-10078

LASER DOPPLER VELOCIMETERS

Measurement of model helicopter rotor flow velocities with a laser Doppler velocimeter
A75-10839

LATERAL CONTROL

Optimum transient response characteristic of a VTOL aircraft with direct side force control --- jet control for optimization of VTOL aircraft flight characteristics
[DLR-FB-73-72] N75-10103

LATERAL STABILITY

SUBJECT INDEX

LATERAL STABILITY

- Extraction from flight data of lateral aerodynamic coefficients for F-8 aircraft with supercritical wing
[NASA-TN-D-7749] N75-10006
- LEADING EDGES**
 - YC-14 system for leading edge boundary layer control
[AIAA PAPER 74-1278] A75-11115
 - On the flow around the leading edge of an aerofoil
N75-10012
 - Methods of visualizing the leading edge separation bubble and analysis of the results
N75-10013
- LIAPUNOV FUNCTIONS**
 - Stabilization of the longitudinal motion of a flight vehicle in the presence of a delay in the control forces
A75-11653
- LIFT**
 - Some remarks on the solution of the lifting line equation
A75-11095
 - Low-speed wing-tunnel measurements of the lift, drag and pitching moment of a series of cropped delta wings
[ARC-R/M-3744] N75-10030
- LIFT AUGMENTATION**
 - Comment on 'Investigation of multi-element airfoils with external flow jet flap' by P. Mavriplis
A75-11084
 - The externally-blown jet flap - A powered-lift concept for STOL
A75-11085
 - Experimental study of spanwise air jet influence on wing aerodynamic characteristics
A75-12096
 - Kasprzyk's revelatory wing --- for gliders
A75-12474
 - Performance improvement through control configured vehicle concept --- active control systems for aircraft life augmentation
[NASA-TT-P-15998] N75-10059
- LIFT DEVICES**
 - The nature, development and effect of the viscous flow around an aerofoil with high-lift devices
[ARC-CP-1258] N75-10021
- LIFT DRAG RATIO**
 - The design of a series of warped slender wings for subsonic speeds
[ARC-CP-1263] N75-10022
- LIFTING BODIES**
 - The problem of three-dimensional lifting potential flow and its solution by means of surface singularity distribution
A75-12345
 - Lifting surface theory applied to fixed wings and propellers
N75-10016
- LIGHT AIRCRAFT**
 - Stability limits for downsprings --- on light aircraft
A75-12618
- LIGHT TRANSMISSION**
 - Preliminary test results of the 'oblique ray' installation --- for atmospheric light transmission
A75-11641
- LIGHTNING**
 - Lightning protection for advanced aircraft radomes based on the segmented lightning diverter strip
A75-10877
- LINEAR PROGRAMMING**
 - A policy study of subsidized air service
[AIAA PAPER 74-1274] A75-11111
- LINKAGES**
 - Determination of the forces in the retractor of a three-dimensional landing gear mechanism
[AD-784257] N75-10078
- LIQUID HYDROGEN**
 - The use of hydrogen in commercial aircraft - An assessment
A75-10542
 - Advanced supersonic technology concept study: Hydrogen fueled configuration
[NASA-CR-114718] N75-10943

- A comparison of optimum JP and LH2 turbofan engines designed for two subsonic transport missions
[NASA-TN-X-71622] N75-10945
- LOAD DISTRIBUTION (FORCES)**
 - Evaluation of the accuracy of two helicopter rotor theories
[PFA-124] N75-10020
- LOADING OPERATIONS**
 - An exploratory flight investigation of helicopter sling-load placements using a closed-circuit television as a pilot aid
[NASA-TN-D-7776] N75-10009
- LOGISTICS MANAGEMENT**
 - Interservice utility helicopter reliability and maintainability comparative analysis
[AD-784177] N75-10080
- LONGITUDINAL CONTROL**
 - Application of methods of abstract algebra to the synthesis of an automatic system for controlling the longitudinal motion of an aircraft
A75-11121
- LONGITUDINAL STABILITY**
 - The development program for the F-15 inlet
[AIAA PAPER 74-1061] A75-10256
 - Stabilization of the longitudinal motion of a flight vehicle in the presence of a delay in the control forces
A75-11653
- LOW COST**
 - Teledyne aims at low-cost engines
A75-12722
- LUBRICATING OILS**
 - A case study of ultra high rate of wear experienced in a gear tooth flank
[ASLE PREPRINT 74LC-6B-2] A75-12188
 - Investigation and optimization of micro-oxidation techniques employed in gas turbine engine oil characterization
[AD-784787] N75-11359
- LUBRICATION**
 - Lubricity of jet A-1 and JP-4 fuels --- as indicated by wear friction
[AD-784772] N75-11115

M

- MAGNETIC RECORDING**
 - Acoustics of the sonic boom --- Book
A75-13023
- MAGNETOHYDRODYNAMIC GENERATORS**
 - Development of explosively driven MHD generator for short pulse aircraft high power. Part 1: Analytical studies. Part 2: Experimental studies. Part 3: Design studies
[AD-784903] N75-11764
- MAN MACHINE SYSTEMS**
 - Avionics systems in the management of air transportation
[AIAA PAPER 74-1294] A75-12246
 - Flight management - Pilot procedures and system interfaces for the 1980-1990's
[AIAA PAPER 74-1297] A75-12248
- MANAGEMENT PLANNING**
 - Avionics systems in the management of air transportation
[AIAA PAPER 74-1294] A75-12246
- MARINE ENVIRONMENTS**
 - Teledyne aims at low-cost engines
A75-12722
- MARKET RESEARCH**
 - Optimal competition in high density markets
[AIAA PAPER 74-1275] A75-11112
- MARKETING**
 - A policy study of subsidized air service
[AIAA PAPER 74-1274] A75-11111
- MASS TRANSFER**
 - Heat and mass transfer in engines of flight vehicles --- Russian book
A75-10203
- MATERIALS HANDLING**
 - Helicopter dropight
[AD-784551] N75-10084
- MATHEMATICAL MODELS**
 - A flow field model for, and some studies on the drag of, an engine exhaust system at transonic flight speeds
[AIAA PAPER 74-1175] A75-10325

SUBJECT INDEX

NOISE REDUCTION

A wind energy conversion system based on the tracked-vehicle airfoil concept A75-10518

Performance limitation of a hypersonic ramjet engine due to reaction kinetics A75-11046

Stress and vibration analysis with the aid of models; Meeting, Stuttgart, West Germany, October 4, 5, 1973, Reports A75-11672

MATHEMATICAL TABLES
Tabulated values of combinations of cyclic and hyperbolic functions N75-10052

MEASURE AND INTEGRATION
A calculation method for the two dimensional turbulent flow over a slotted flap [ARC-CP-1267] N75-10023

MEASURING INSTRUMENTS
NASA-Langley helicopter tower instrumentation systems [NASA-CR-132522] N75-10106

MECHANICAL DEVICES
Determination of the forces in the retractor of a three-dimensional landing gear mechanism [AD-784257] N75-10078

MECHANICAL PROPERTIES
Development of Slip Cast Fused Silica radomes A75-10870

Thermal plastic radomes A75-10880

Automated computerized ultrasonic rating system provides new level of design confidence A75-12931

METAL FATIGUE
Pretting in aircraft turbine engines A75-10925

Failure analyses of aircraft accidents. II A75-12726

METAL MATRIX COMPOSITES
Boron/aluminum for space applications A75-13048

METAL SHEETS
Laminated metallic structure - Advanced applications A75-13046

METAL-METAL BONDING
Selected problems concerning the strength of a bonded heavily loaded Dural structure A75-12475

METEOROLOGICAL FLIGHT
Development of an armored T-28 aircraft for probing hailstorms A75-10638

MICROANALYSIS
Aerospace Research --- topics on airfoil profiles, flow visualization, ablative materials, microanalysis, and filter analysis [ESRO-TT-90] N75-10011

MICROWAVE EQUIPMENT
Doppler radar boast design innovations --- for aircraft A75-10625

Flight demonstration of the feasibility of a scanning beam microwave landing system N75-10919

MICROWAVE INTERFEROMETERS
B-1 forward radome fabrication A75-10881

MIDAIR COLLISIONS
Safety and air navigation A75-12372

Annual review of aircraft accident data: US General Aviation calendar year 1971 [NTSB-ARG-74-2] N75-10037

MILITARY AIR FACILITIES
Fire protection of large Air Force hangars [AD-784869] N75-10961

MILITARY AIRCRAFT
Drone/EPV systems --- Remotely Piloted Vehicle as weapon system A75-10186

Rapid calculation of propulsion system installation corrections --- for jet engines [AIAA PAPER 74-1174] A75-10324

Head-up display optics --- application to weapon aiming systems in military aircraft N75-10780

High sink-rate landing testing of Navy aircraft N75-10924

MILITARY HELICOPTERS
Elastic pitch beam tail rotor operational suitability investigation [AD-784595] N75-10069

Low temperature testing of an AH-1G helicopter equipped with elastomeric flapping and feathering bearings in the main rotor [AD-784189] N75-10081

Yaw axis stability augmentation system flight test report --- flight tests of H-58 helicopter [AD-784134] N75-10083

US Army helicopter icing tests N75-10932

MILITARY TECHNOLOGY
Mini-EPV's for cheap and no risk air power A75-10623

The American STAGG gas generator program A75-11721

MIL-H-83282, fire resistant hydraulic fluid --- for military aircraft A75-13052

MISSILE CONFIGURATIONS
Fundamental geometric and aerodynamic characteristics of aircraft and finned rockets --- Russian book A75-11577

Aerodynamic symmetry of aircraft and guided missiles --- development of configurations to eliminate certain force and moment derivatives [AD-784254] N75-10070

MISSILE CONTROL
A conceptual approach to applying singular perturbation methods to variational problems --- in optimal control A75-11895

An elastic flight vehicle as an automatic control plant --- Russian book A75-12329

MISSILE DESIGN
Teledyne aims at low-cost engines A75-12722

MISSILE SIMULATORS
The development of an accurate aerodynamic simulation model for the SAM-D missile with a relatively small computer storage requirement A75-10414

MOMENTS OF INERTIA
Experimental determination of airplane mass and inertial characteristics [NASA-TR-R-433] N75-10062

MONITORS
From creaking cracks to breaking beams - A review of acoustic emission for aircraft structure A75-13035

MONOPULSE RADAR
Radomes for high gain arrays A75-10858

N

NICKEL ALLOYS
Development of high strength cast superalloys with hot corrosion resistance A75-13039

NOISE GENERATORS
Fluid dynamic aspects of jet noise generation [NASA-CR-140673] N75-10088

NOISE INTENSITY
Effective data monitoring during airplane flyover noise tests N75-10928

NOISE POLLUTION
Helicopter - People and places /14th Cierva Memorial Lecture/ --- emphasizing safety factors and passenger travel A75-10187

NOISE REDUCTION
Turbofan noise reduction using a near sonic inlet [AIAA PAPER 74-1098] A75-10281

Noise and atmospheric emissions - An airline view A75-11083

Model 301 HLH/ATC (Heavy Lift Helicopter/Advanced Technology Component) transmission noise reduction program [AD-784132] N75-10063

A computing method for sound propagation through a nonuniform jet stream [NASA-TM-X-71941] N75-10359

NOISE TOLERANCE

SUBJECT INDEX

Fleet retrofit report
[NASA-CR-137586] N75-10941

NOISE TOLERANCE
A survey of aircraft noise annoyance in an area of invariant noise to eliminate the effects on annoyance of varying noise exposure [TT-7405] N75-10755

NONDESTRUCTIVE TESTS
Automated computerized ultrasonic rating system provides new level of design confidence A75-12931
A computer automated ultrasonic inspection system for aircraft forgings A75-12933
From creaking cracks to breaking beams - A review of acoustic emission for aircraft structure A75-13035
Weldability and quality of titanium alloy weldments A75-13044

NONFLAMMABLE MATERIALS
MIL-H-83282, fire resistant hydraulic fluid --- for military aircraft A75-13052

NOZZLE DESIGN
F-15 nozzle/afterbody integration [AIAA PAPER 74-1100] A75-10283
V/STOL deflector concepts [AIAA PAPER 74-1168] A75-10319
Oscillating jet nozzles for V/STOL application [AIAA PAPER 74-1189] A75-10337

NOZZLE EFFICIENCY
Installation benefits of the single-engine exhaust nozzle on the YF-16 [AIAA PAPER 74-1101] A75-12571

NOZZLE FLOW
Influence of swirling flow on heat transfer in nozzles A75-10204
Two dimensional transonic two-phase flow in axisymmetric nozzles [AIAA PAPER 74-1088] A75-10275
An analytic description of hypermixing and test of an improved nozzle [AIAA PAPER 74-1190] A75-10338
Fluid dynamic aspects of jet noise generation [NASA-CR-140673] N75-10088

NOZZLE GEOMETRY
Scale model testing of the jet noise characteristics of the JT8D refan engine nozzle system [NASA-CR-134618] N75-10091

NUMERICAL CONTROL
The digital electronic propulsion control system - Problems and payoffs [AIAA PAPER 74-1068] A75-10261
Automated computerized ultrasonic rating system provides new level of design confidence A75-12931

O

OBULATE SPHEROIDS
Aerodynamic torques on rotating oblate spheroids A75-11151

OFFSHORE DOCKING
Navigation in the use of helicopters offshore A75-12373

ONBOARD EQUIPMENT
S-3A Viking - Carrier's shield A75-13149

OPERATIONAL PROBLEMS
Operational effectiveness of transport aircraft [NASA-TT-F-810] N75-10036
Simulation studies of STOL airplane operations in metropolitan downtown and airport air traffic control environments [NASA-TN-D-7740] N75-10038

OPTICAL EQUIPMENT
Helicopter dropsight [AD-784551] N75-10084

OPTIMAL CONTROL
Powerplant energy management --- transport aircraft engine thrust control [AIAA PAPER 74-1066] A75-10259
A conceptual approach to applying singular perturbation methods to variational problems --- in optimal control A75-11895

Optimal control theory investigation of propotor/wing response to vertical gust [NASA-TN-X-62384] N75-10057
Optimum transient response characteristic of a VTOL aircraft with direct side force control --- jet control for optimization of VTOL aircraft flight characteristics [DLR-FB-73-72] N75-10103

OPTIMIZATION
Resolving the contradictions between airplane component weight and drag A75-12077
Optimization of automated static tests of gas turbine engines --- Russian book A75-12332

OSCILLATING FLOW
Oscillating jet nozzles for V/STOL application [AIAA PAPER 74-1189] A75-10337
Application of the polar coordinate method to oscillating wing configurations [SAAB-TN-69] N75-10010

OXIDATION
Investigation and optimization of micro-oxidation techniques employed in gas turbine engine oil characterization [AD-784787] N75-11359

OXIDES
Oxide dispersion strengthened alloys for aircraft turbine engine vanes A75-13040

OZONE
Atmospheric ozone and its influence on the operation of supersonic transport A75-11639

P

PANELS
Anisotropic dielectric panel analysis --- for radome materials A75-10859

PARABOLIC DIFFERENTIAL EQUATIONS
An extension of the 'parabolic method' to the calculation of transonic flows A75-10837

PARACHUTES
Wind tunnel tests of modified cross, hemisflo, and disk-gap-band parachutes with emphasis in the transonic range [NASA-TN-D-7759] N75-10007

PASSENGER AIRCRAFT
LTA in the USA - Here's where it stands today --- lighter than air vehicles [AIAA PAPER 74-1280] A75-11116
Short SD3-30 --- twin turboprop commuter aircraft with wide body design A75-12420

PAVEMENTS
Evaluation of construction techniques for new antihydroplaning overlays [AD-784870] N75-10959

PERFORMANCE PREDICTION
Prediction of ground effects for VTOL aircraft with twin lifting jets [AIAA PAPER 74-1167] A75-10318
A computer program for aircraft thrust ejector analyses [AIAA PAPER 74-1191] A75-10339
Installation benefits of the single-engine exhaust nozzle on the YF-16 [AIAA PAPER 74-1101] A75-12571
Some factors affecting the use of lighter than air systems --- economic and performance estimates for dirigibles and semi-buoyant hybrid vehicles [NASA-TN-X-62374] N75-10004
Critical review of methods to predict the buffet capability of aircraft [AGARD-R-623] N75-10053
Development and experimental verification of procedures to determine nonlinear load-deflection characteristics of helicopter substructures subjected to crash forces. Volume 1: Development of simplified analytical techniques to predict typical helicopter airframe crushing characteristics and the formulation of design procedures [AD-784191] N75-10940

SUBJECT INDEX

PROPULSION SYSTEM PERFORMANCE

- The prediction of structural response to buffet
flow: A state-of-the-art review
[NASA-TM-X-72627] N75-11372
- PERFORMANCE TESTS**
- An analytic description of hypermixing and test of
an improved nozzle
[AIAA PAPER 74-1190] A75-10338
- Performance of a model cascade thrust reverser for
short-haul applications
[AIAA PAPER 74-1171] A75-11299
- MIL-H-83282, fire resistant hydraulic fluid ---
for military aircraft A75-13052
- Endurance testing of an LM-726-4 elastomeric pitch
change bearing
[AD-784140] N75-10074
- Optimum rate of climb for high performance aircraft
[AD-784112] N75-10076
- T and E guidelines for aircraft systems
[AD-784549] N75-10085
- Two-stage fan. 2: Data and performance with
redesigned second stage rotor uniform and
distorted inlet flows
[NASA-CR-134710] N75-10944
- PERTURBATION THEORY**
- A conceptual approach to applying singular
perturbation methods to variational problems ---
in optimal control A75-11895
- PHASED ARRAYS**
- EM window thermal barriers --- on supersonic
aircraft A75-10857
- Radomes for high gain arrays A75-10858
- PIGGYBACK SYSTEMS**
- Shuttle orbiter flight test plan evolves A75-12720
- PILOT PERFORMANCE**
- Flight management - Pilot procedures and system
interfaces for the 1980-1990's
[AIAA PAPER 74-1297] A75-12248
- A study on aircraft map display location and
orientation A75-12725
- Effects of ground-based aircraft simulator motion
conditions upon prediction of pilot proficiency,
part 1
[AD-783256] N75-10112
- PILOT TRAINING**
- Flight fidelity testing of US Navy operational
flight trainers N75-10915
- PITCH (INCLINATION)**
- Pitch damping of helicopter rotor with nonuniform
inflow A75-11094
- PITCHING MOMENTS**
- Measurement of pitching moment on an oscillating
rectangular wing at transonic speeds using the
resonance method A75-12829
- Low-speed wing-tunnel measurements of the lift,
drag and pitching moment of a series of cropped
delta wings
[ARC-R/M-3744] N75-10030
- PLASTIC AIRCRAFT STRUCTURES**
- Thermal plastic radomes A75-10880
- B-1 forward radome fabrication A75-10881
- POHLHAUSEN METHOD**
- Axial flow past a cylinder with suction A75-10140
- POLLUTION CONTROL**
- Noise and atmospheric emissions - An airline view
A75-11083
- POLYCARBONATES**
- Polycarbonate aircraft transparencies A75-13041
- POLYIMIDES**
- Polyimide materials development for high
temperature, broadband radome applications A75-10872
- POLYMERS**
- Emission of smoke and fumes at temperatures up to
500 C A75-10799
- POLYURETHANE RESINS**
- Improved primer coating systems for the
transportation industries A75-13043
- POSITION INDICATORS**
- A study on aircraft map display location and
orientation A75-12725
- POTENTIAL FLOW**
- The problem of three-dimensional lifting potential
flow and its solution by means of surface
singularity distribution A75-12345
- Potential flow past annular aerofoils A75-12619
- POWER SUPPLIES**
- High-performance hydraulic system powers aircraft
simulator A75-10426
- PRECIPITATION HARDENING**
- Oxide dispersion strengthened alloys for aircraft
turbine engine vanes A75-13040
- PRECISION**
- Precision in LCHTP testing --- of aircraft jet
engines N75-10490
- PREDICTION ANALYSIS TECHNIQUES**
- Lifetime prediction methods for elevated
temperature fatigue --- in aircraft jet engines
N75-10493
- PRESSURE DISTRIBUTION**
- An analytical procedure for the calculation of
attached and separated subsonic diffuser flows
[AIAA PAPER 74-1173] A75-10323
- Pressure distribution on two wings with curved
leading edges at supersonic speeds
[ARC-R/M-3741] N75-10028
- PRESSURE GRADIENTS**
- Statistical averages of subsonic inlet distortion
[AIAA PAPER 74-1197] A75-10342
- PRIMERS (COATINGS)**
- Improved primer coating systems for the
transportation industries A75-13043
- PROJECT PLANNING**
- The American STAGG gas generator program A75-11721
- PROJECTILES**
- Experimental hydraulic ram studies (FY 74)
[AD-784736] N75-11230
- PROPELLER BLADES**
- Lifting surface theory applied to fixed wings and
propellers N75-10016
- PROPULSION SYSTEM PERFORMANCE**
- The digital electronic propulsion control system -
Problems and payoffs
[AIAA PAPER 74-1068] A75-10261
- Expendable solid propellant boost motors for small
target aircraft
[AIAA PAPER 74-1125] A75-10292
- Rapid calculation of propulsion system
installation corrections --- for jet engines
[AIAA PAPER 74-1174] A75-10324
- Performance limitation of a hypersonic ramjet
engine due to reaction kinetics A75-11046
- YF-16 inlet design and performance
[AIAA PAPER 74-1062] A75-11279
- Recent flight experience with the F100 engine in
the YF-16
[AIAA PAPER 74-1163] A75-11298
- Flight-test techniques for obtaining valid
comparisons of wind-tunnel and flight results
from tests on a YF-12 mixed-compression inlet
[AIAA PAPER 74-1195] A75-11301
- High-performance centrifugal compressors A75-11739
- Design objectives - Air transportation A75-13029
- Experience with the NRC 10 feet by 20 feet V/STOL
propulsion tunnel: Some practical aspects of
V/STOL engine model testing
[DME/NAE-1973(2)] N75-10107
- Low cycle high temperature fatigue --- in aircraft
jet engines: conference proceedings
[AGARD-CP-155] N75-10487

PROTOTYPES

Precision in LCHTF testing --- of aircraft jet engines
N75-10490

The effect of cycle parameters on high temperature low cycle fatigue --- in aircraft jet engines
N75-10491

Design procedures for elevated temperature low-cycle fatigue --- as applied to aircraft jet engines
N75-10494

Advanced supersonic technology concept study: Hydrogen fueled configuration
[NASA-CR-114718]
N75-10943

PROTOTYPES

Applications of graphite and aramid composites on the YF-17 prototype fighter
A75-13047

Critical analyses and laboratory research work at the stage of aircraft preliminary design
[NASA-TT-F-15996]
N75-10055

Q

QUALITY CONTROL

FAA Advisory Circular 00-41 Quality System Certification Program
A75-10675

A new look at qualification of aircraft equipment
A75-12122

Weldability and quality of titanium alloy weldments
A75-13044

R

RADAR ANTENNAS

B-1 forward radome
A75-10866

RADAR APPROACH CONTROL

Automatic flying of curved approach paths: A computer and flight investigation
[RAE-TR-73154]
N75-10043

RADAR DETECTION

Resistance of radar systems against interference
N75-11797

RADAR ECHOES

Aircraft-velocity measurement through radar-altimeter echo with noncoherent detection
[SLA-74-112]
N75-10290

RADAR SCANNING

Radomes for high gain arrays
A75-10858

RADAR TRACKING

Influence of inherent carrier motion on a frequency selection system
A75-12060

RADIO ALTIMETERS

Aircraft-velocity measurement through radar-altimeter echo with noncoherent detection
[SLA-74-112]
N75-10290

RADIO CONTROL

A technique for displaying flight information in the field of view of binoculars for use by the pilots of radio controlled models
[NASA-TN-X-72015]
N75-10786

RADIO FREQUENCY HEATING

Radio frequency heating of radomes in an aerodynamic environment
A75-10876

RADIO FREQUENCY INTERFERENCE

Electromagnetic compatibility assurance tests for airborne systems controls in an RF-polluted environment
[AIAA PAPER 74-1096]
A75-10279

Interference with aircraft radio navigation and communications by precipitation static from ice and snow clouds: Electrostatic wind tunnel experiments
[AD-784623]
N75-10046

Resistance of radar systems against interference
N75-11797

RADIO NAVIGATION

Interference with aircraft radio navigation and communications by precipitation static from ice and snow clouds: Electrostatic wind tunnel experiments
[AD-784623]
N75-10046

SUBJECT INDEX

RADOME MATERIALS

State of radome technology - 1974; Proceedings of the Twelfth Symposium on Electromagnetic Windows, Georgia Institute of Technology, Atlanta, Ga., June 12-14, 1974
A75-10851

EM window thermal barriers --- on supersonic aircraft
A75-10857

Radomes for high gain arrays
A75-10858

Anisotropic dielectric panel analysis --- for radome materials
A75-10859

B-1 forward radome
A75-10866

Development of Slip Cast Fused Silica radomes
A75-10870

Polyimide materials development for high temperature, broadband radome applications
A75-10872

A rain erosion evaluation of three-dimensional woven silica and reaction sintered silicon nitride as state-of-the-art radome materials
A75-10875

Lightning protection for advanced aircraft radomes based on the segmented lightning diverter strip
A75-10877

Thermal plastic radomes
A75-10880

B-1 forward radome fabrication
A75-10881

RADOMES

Radio frequency heating of radomes in an aerodynamic environment
A75-10876

RAIN IMPACT DAMAGE

A rain erosion evaluation of three-dimensional woven silica and reaction sintered silicon nitride as state-of-the-art radome materials
A75-10875

RAMJET ENGINES

Performance limitation of a hypersonic ramjet engine due to reaction kinetics
A75-11046

Studies of slurry fueled propulsion systems
[AD-784362]
N75-11114

RAY TRACING

Preliminary test results of the 'oblique ray' installation --- for atmospheric light transmission
A75-11641

REACTION KINETICS

Performance limitation of a hypersonic ramjet engine due to reaction kinetics
A75-11046

REAL TIME OPERATION

Real-time simulation of the TF30-P-3 turbofan engine using a hybrid computer
[NASA-TN-X-3106]
N75-10095

Real-time measuring procedure and measuring equipment for recording the radiation patterns of aircraft antennas in flight
[ESRO-TT-74]
N75-10292

RECONNAISSANCE AIRCRAFT

Mini-RPV's for cheap and no risk air power
A75-10623

RECTANGULAR WINGS

Some remarks on the solution of the lifting line equation
A75-11095

Calculation of the aerodynamic characteristics of a system of rectangular wings moving near a screening surface
A75-12078

Experimental study of spanwise air jet influence on wing aerodynamic characteristics
A75-12096

Measurement of pitching moment on an oscillating rectangular wing at transonic speeds using the resonance method
A75-12829

REINFORCED PLASTICS

B-1 forward radome
A75-10866

Thermal plastic radomes
A75-10880

B-1 forward radome fabrication
A75-10881

SUBJECT INDEX

ROTOR AERODYNAMICS

- Applications of graphite and aramid composites on the YF-17 prototype fighter A75-13047
- RELIABILITY ANALYSIS**
Reliability of laboratory tests of VSTOL and other long duration noises [NASA-CR-2471] N75-10093
- RELIABILITY ENGINEERING**
Improved reliability of turbine engines through common sense maintenance A75-11087
Reliability and maintainability of aircraft jet engines. II A75-12125
Teledyne aims at low-cost engines A75-12722
Interservice utility helicopter reliability and maintainability comparative analysis [AD-784177] N75-10080
- REMOTELY PILOTED VEHICLES**
Drone/RPV systems --- Remotely Piloted Vehicle as weapon system A75-10186
Mini-RPV's for cheap and no risk air power A75-10623
An inexpensive jet engine, dream or reality --- for remotely piloted vehicles A75-11724
A study of stabilization techniques for small, fixed-wing, remotely piloted aircraft [AD-784109] N75-10079
NASA Flight Research Center scale F-15 remotely piloted research vehicle program N75-10912
A remotely augmented vehicle approach to flight testing RPV control systems [NASA-TM-X-56029] N75-10936
- RESEARCH AIRCRAFT**
The rotor systems research aircraft - A flying wind tunnel [AIAA PAPER 74-1277] A75-11114
YC-14 system for leading edge boundary layer control [AIAA PAPER 74-1278] A75-11115
- RESEARCH PROJECTS**
The R and D simulator: A new T and E tool --- application of simulators for research and development of aircraft systems N75-10914
- RESEARCH VEHICLES**
NASA Flight Research Center scale F-15 remotely piloted research vehicle program N75-10912
- RESONANT VIBRATION**
Measurement of pitching moment on an oscillating rectangular wing at transonic speeds using the resonance method A75-12829
- RHEOELECTRICAL SIMULATION**
Potential flow past annular aerofoils A75-12619
Analog simulation of the small perturbation equation applied to transonic flows --- and wall and cascade flows N75-10370
- RIGID ROTORS**
Hingeless rotorcraft flight dynamics --- research projects to analyze aerodynamic characteristics of rotary wings [AGARD-AG-197] N75-10003
Techniques for improving the stability of soft inplane hingeless rotors [NASA-TM-X-62390] N75-10058
- RIGID STRUCTURES**
Effect of the rotation rate of the rotor on the angular rigidity of the elastic suspension of a Houve gyroscope N75-11241
- RIGIDITY**
Analysis of multihinge tailplane with account for control surface deflection A75-12088
- ROCKET ENGINE DESIGN**
Expendable solid propellant boost motors for small target aircraft [AIAA PAPER 74-1125] A75-10292
- ROCKET ENGINES**
Heat and mass transfer in engines of flight vehicles --- Russian book A75-10203
- ROCKET THRUST**
Steam rockets for takeoff A75-11373
- ROCKET VEHICLES**
Fundamental geometric and aerodynamic characteristics of aircraft and finned rockets --- Russian book A75-11577
- ROLLING MOMENTS**
Static aeroelasticity and the flying wing, revisited A75-12622
- ROTARY WING AIRCRAFT**
The rotor systems research aircraft - A flying wind tunnel [AIAA PAPER 74-1277] A75-11114
- ROTARY WINGS**
Measurement of model helicopter rotor flow velocities with a laser Doppler velocimeter A75-10839
Pitch damping of helicopter rotor with nonuniform inflow A75-11094
The SA. 360 'Dauphin' - Definition and development --- helicopter design A75-11722
Calculation of helicopter main rotor blade deformation with account for control flexibility A75-12087
Structural advances in helicopter rotor blade technology A75-13045
Hingeless rotorcraft flight dynamics --- research projects to analyze aerodynamic characteristics of rotary wings [AGARD-AG-197] N75-10003
Lifting surface theory applied to fixed wings and propellers N75-10016
Evaluation of the accuracy of two helicopter rotor theories [PPA-124] N75-10020
Some calculations for air resonance of a helicopter with non-articulated rotor blades [ARC-H/M-3743] N75-10029
Endurance testing of an LM-726-4 elastomeric pitch change bearing [AD-784140] N75-10074
Investigation of the effects of blade structural design parameters on helicopter stall boundaries [AD-784594] N75-10075
Low temperature testing of an AH-1G helicopter equipped with elastomeric flapping and feathering bearings in the main rotor [AD-784189] N75-10081
- ROTATING BODIES**
Turbulent mean velocity measurements on a rotating cone A75-10043
Aerodynamic torques on rotating oblate spheroids A75-11151
- ROTATING SHAFTS**
Mainshaft seals for small gas turbine engines [ASLE PREPRINT 74LC-1C-2] A75-12197
- ROTOR AERODYNAMICS**
Pitch damping of helicopter rotor with nonuniform inflow A75-11094
Hingeless rotorcraft flight dynamics --- research projects to analyze aerodynamic characteristics of rotary wings [AGARD-AG-197] N75-10003
Elastic pitch beam tail rotor operational suitability investigation [AD-784595] N75-10069
Investigation of the effects of blade structural design parameters on helicopter stall boundaries [AD-784594] N75-10075
Low temperature testing of an AH-1G helicopter equipped with elastomeric flapping and feathering bearings in the main rotor [AD-784189] N75-10081
Two-stage fan. 2: Data and performance with redesigned second stage rotor uniform and distorted inlet flows [NASA-CR-134710] N75-10944

ROTOR BLADES

SUBJECT INDEX

ROTOR BLADES

- A difference method for axisymmetric supersonic flow in rotating annular cascades with local subsonic regions A75-11045
- Some calculations for air resonance of a helicopter with non-articulated rotor blades [ARC-R/H-3743] N75-10029
- Techniques for improving the stability of soft inplane hingeless rotors [NASA-TM-X-62390] N75-10058
- ROTOR BLADES (TURBOMACHINERY)**
- Single-stage experimental evaluation of tandem-airfoil rotor and stator blading for compressors, part 8 [NASA-CR-134713] N75-10947
- ROTORS**
- Isolated rotor noise due to inlet distortion or turbulence [NASA-CR-2479] N75-10094
- Number of bars and torque of squirrel cage rotors --- for an asynchronous motor [RAE-LIB-TRANS-1781] N75-11154
- RUNWAYS**
- Skid resistance tests in support of the F-4 rain tire program at the Air Force Flight Test Center [AD-784801] N75-10958
- Evaluation of construction techniques for new antihydroplaning overlays [AD-784870] N75-10959

S

- S-3 AIRCRAFT**
- Doppler radar boast design innovations --- for aircraft A75-10625
- S-3A Viking - Carrier's shield A75-13149
- SAFETY DEVICES**
- Lightning protection for advanced aircraft radomes based on the segmented lightning diverter strip A75-10877
- SAFETY FACTORS**
- Helicopter - People and places /14th Cierva Memorial Lecture/ --- emphasizing safety factors and passenger travel A75-10187
- SAFETY MANAGEMENT**
- Safety and air navigation A75-12372
- SANDWICH STRUCTURES**
- Polyimide materials development for high temperature, broadband radome applications A75-10872
- Selected problems concerning the strength of a bonded heavily loaded Dural structure A75-12475
- SCALE MODELS**
- Comparison of the acoustic characteristics of large-scale models of several propulsive-lift concepts [AIAA PAPER 74-1094] A75-10278
- Scale model testing of the jet noise characteristics of the JT8D refan engine nozzle system [NASA-CR-134618] N75-10091
- NASA Flight Research Center scale F-15 remotely piloted research vehicle program N75-10912
- SCREEN EFFECT**
- Calculation of the aerodynamic characteristics of a system of rectangular wings moving near a screening surface A75-12078
- SEALS (STOPPERS)**
- Sealing technology for aircraft gas turbine engines [AIAA PAPER 74-1188] A75-10336
- Mainshaft seals for small gas turbine engines [ASLE PREPRINT 74LC-1C-2] A75-12197
- SELF SEALING**
- Sealing technology for aircraft gas turbine engines [AIAA PAPER 74-1188] A75-10336
- SEPARATED FLOW**
- Some problems of the canard configuration. I A75-12473
- On the flow around the leading edge of an aerofoil N75-10012

- Methods of visualizing the leading edge separation bubble and analysis of the results N75-10013
- SHAFTS (MACHINE ELEMENTS)**
- HLH/ATC engine shaft support bearing development program [AD-784593] N75-10097
- SHARP LEADING EDGES**
- Pressure distribution on two wings with curved leading edges at supersonic speeds [ARC-R/H-3741] N75-10028
- SHOCK WAVE INTERACTION**
- The application of boundary layer suction to suppress strong shock-induced separation in supersonic inlets [AIAA PAPER 74-1063] A75-10257
- Flow immediately behind a step in a supersonic combustor [AIAA PAPER 74-1161] A75-10317
- SHORT HAUL AIRCRAFT**
- Performance of a model cascade thrust reverser for short-haul applications [AIAA PAPER 74-1171] A75-11299
- Short SD3-30 --- twin turboprop commuter aircraft with wide body design A75-12420
- Design objectives - Air transportation A75-13029
- SHORT TAKEOFF AIRCRAFT**
- Ejector thrust augmentation for STOL aircraft applications [AIAA PAPER 74-1192] A75-10340
- The externally-blown jet flap - A powered-lift concept for STOL A75-11085
- Simulation studies of STOL airplane operations in metropolitan downtown and airport air traffic control environments [NASA-TN-D-7740] N75-10038
- Analysis of a flare-director concept for an externally blown flap STOL aircraft [NASA-TN-D-7760] N75-10061
- Developing STOL operational criteria N75-10911
- SIDE INLETS**
- The external drag of fuselage side intakes: Rectangular intakes with compression surfaces vertical [ARC-CP-1269] N75-10025
- SIGNAL RECEPTION**
- Interference with aircraft radio navigation and communications by precipitation static from ice and snow clouds: Electrostatic wind tunnel experiments [AD-784623] N75-10046
- SILICON DIOXIDE**
- Development of Slip Cast Fused Silica radomes A75-10870
- A rain erosion evaluation of three-dimensional woven silica and reaction sintered silicon nitride as state-of-the-art radome materials A75-10875
- SILICON NITRIDES**
- A rain erosion evaluation of three-dimensional woven silica and reaction sintered silicon nitride as state-of-the-art radome materials A75-10875
- SIMILARITY THEOREM**
- Applications of similarity laws in the case of turbomachines A75-11674
- SINGULARITY (MATHEMATICS)**
- The problem of three-dimensional lifting potential flow and its solution by means of surface singularity distribution A75-12345
- SKIDDING**
- Skid resistance tests in support of the F-4 rain tire program at the Air Force Flight Test Center [AD-784801] N75-10958
- SLENDER WINGS**
- The design of a series of warped slender wings for subsonic speeds [ARC-CP-1263] N75-10022
- Low-speed wing-tunnel measurements of the lift, drag and pitching moment of a series of cropped delta wings [ARC-R/H-3744] N75-10030

SUBJECT INDEX

STRUCTURAL DESIGN CRITERIA

SLIP CASTING Development of Slip Cast Fused Silica radomes A75-10870	STATIC STABILITY Static aeroelasticity and the flying wing, revisited A75-12622
SLOTTED WIND TUNNELS Ground effect for V/STOL aircraft configurations and its simulation in the wind tunnel. Part 3: The tangentially blown ground as an alternative to a moving ground: Application to the NASA-Ames 40 by 80-foot wind tunnel [NASA-CR-114497] N75-10005	STATIC TESTS Optimization of automated static tests of gas turbine engines --- Russian book A75-12332
SLURRY PROPELLANTS Studies of slurry fueled propulsion systems [AD-784362] N75-11114	High acceleration cockpits for advanced fighter aircraft. Volume 3: Test plan --- static tests and mission profiles [AD-783602] N75-10066
SMALL PERTURBATION FLOW A method of obtaining sub-critical compressible velocities for two-dimensional aerofoils from an exact inviscid incompressible solution A75-10189	STATISTICAL ANALYSIS Annual review of aircraft accident data: US General Aviation calendar year 1971 [NTSB-ARG-74-2] N75-10037
Analog simulation of the small perturbation equation applied to transonic flows --- and wall and cascade flows N75-10370	Statistical analysis of general aviation VG-VGH data [NASA-CR-132531] N75-10933
SMOKE TRAILS Emission of smoke and fumes at temperatures up to 500 C A75-10799	STATOR BLADES Single-stage experimental evaluation of tandem-airfoil rotor and stator blading for compressors, part 8 [NASA-CR-134713] N75-10947
SOCIAL FACTORS Helicopter - People and places /14th Cierva Memorial Lecture/ --- emphasizing safety factors and passenger travel A75-10187	STEAM Steam rockets for takeoff A75-11373
SOLID PROPELLANT ROCKET ENGINES Expendable solid propellant boost motors for small target aircraft [AIAA PAPER 74-1125] A75-10292	STORMS (METEOROLOGY) Development of an armored T-28 aircraft for probing hailstorms A75-10638
SONIC BOOMS Acoustics of the sonic boom --- Book A75-13023	STRATOSPHERE The 1973 program of measurement of the minor constituents of the stratosphere using the Concorde 001 A75-11720
SOUND FIELDS Fluid dynamic aspects of jet noise generation [NASA-CR-140673] N75-10088	STRESS ANALYSIS Stress and vibration analysis with the aid of models; Meeting, Stuttgart, West Germany, October 4, 5, 1973, Reports A75-11672
SOUND PROPAGATION A computing method for sound propagation through a nonuniform jet stream [NASA-TN-X-71941] N75-10359	Determination of the forces in the retractor of a three-dimensional landing gear mechanism [AD-784257] N75-10078
SPACE SHUTTLE ORBITERS Shuttle orbiter flight test plan evolves A75-12720	STRESS CONCENTRATION Variational-difference method of studying the stressed state of the rim of the turbine disk in a T-shaped tail joint A75-11235
Boron/aluminum for space applications A75-13048	STRESS CORROSION Failure analyses of aircraft accidents. II A75-12726
SPACECRAFT CONSTRUCTION MATERIALS Boron/aluminum for space applications A75-13048	STRESS CORROSION CRACKING Evaluating new aluminum forging alloys A75-12729
SPACECRAFT LANDING Shuttle orbiter flight test plan evolves A75-12720	STRUCTURAL ANALYSIS Practical application of the Howard-Czencow method - Calculation of bent and axially compressed beams. II A75-11375
SPARROW MISSILES Flight testing the F-15/AIM-7P weapon delivery mode N75-10918	STRUCTURAL DESIGN Automated structural design with aeroelastic constraints - A review and assessment of the state of the art A75-11624
SPIN DYNAMICS Aerodynamic torques on rotating oblate spheroids A75-11151	On computer-aided design of aerospace vehicles A75-11626
SPRINGS (ELASTIC) Stability limits for downsprings --- on light aircraft A75-12618	Materials on the move; Proceedings of the Sixth National Technical Conference, Dayton, Ohio, October 8-10, 1974 A75-13028
STABILITY DERIVATIVES Extraction from flight data of lateral aerodynamic coefficients for F-8 aircraft with supercritical wing [NASA-TN-D-7749] N75-10006	Rationale for cost-weight analysis --- in airframe design [AIAA PAPER 74-961] A75-13069
Aerodynamic symmetry of aircraft and guided missiles --- development of configurations to eliminate certain force and moment derivatives [AD-784254] N75-10070	High acceleration cockpits for advanced fighter aircraft. Volume 1: Program summary --- human factors engineering for optimal design [AD-783600] N75-10064
A Saab-Scania developed method for obtaining stability derivatives from flight tests N75-10925	High acceleration cockpits for advanced fighter aircraft. Volume 2: Crew station design/integration --- control and display devices [AD-783601] N75-10065
STABILIZERS (FLUID DYNAMICS) Stability limits for downsprings --- on light aircraft A75-12618	High acceleration cockpits for advanced fighter aircraft. Volume 3: Test plan --- static tests and mission profiles [AD-783602] N75-10066
STATIC DISCHARGERS Technology development report: Results of static electricity discharge system tests (active and passive) heavy lift helicopter [AD-784130] N75-10082	STRUCTURAL DESIGN CRITERIA The CCV concept and specifications [NASA-TT-F-15997] N75-10060

STRUCTURAL FAILURE

SUBJECT INDEX

- High acceleration cockpits for advanced fighter aircraft. Volume 4: Test results
[AD-783603] A75-10067
- STRUCTURAL FAILURE**
Failure analyses of aircraft accidents. II A75-12726
- STRUCTURAL MEMBERS**
Number of bars and torque of squirrel cage rotors --- for an asynchronous motor
[RAE-LIB-TRANS-1781] A75-11154
- STRUCTURAL VIBRATION**
Stress and vibration analysis with the aid of models; Meeting, Stuttgart, West Germany, October 4, 5, 1973, Reports A75-11672
Vibrational investigations on aircraft models in support of flutter calculations A75-11676
- STRUCTURAL WEIGHT**
Resolving the contradictions between airplane component weight and drag A75-12077
- SUBCRITICAL FLOW**
A method of obtaining sub-critical compressible velocities for two-dimensional aerofoils from an exact inviscid incompressible solution A75-10189
- SUBSONIC AIRCRAFT**
Statistical averages of subsonic inlet distortion [AIAA PAPER 74-1197] A75-10342
The use of hydrogen in commercial aircraft - An assessment A75-10542
- SUBSONIC FLOW**
An analytical procedure for the calculation of attached and separated subsonic diffuser flows [AIAA PAPER 74-1173] A75-10323
Potential flow past annular aerofoils A75-12619
Application of the polar coordinate method to oscillating wing configurations [SAAB-TN-69] A75-10010
- SUBSONIC SPEED**
Transonic compressor technology advancements A75-11199
- SUCTION**
Axial flow past a cylinder with suction A75-10140
The application of boundary layer suction to suppress strong shock-induced separation in supersonic inlets [AIAA PAPER 74-1063] A75-10257
- SUPERCritical WINGS**
Extraction from flight data of lateral aerodynamic coefficients for F-8 aircraft with supercritical wing [NASA-TN-D-7749] A75-10006
- SUPERSONIC AIRCRAFT**
Applied aerodynamics --- Russian book on experimental methods, measurement and calculation techniques A75-13026
- SUPERSONIC COMBUSTION RAMJET ENGINES**
Flow immediately behind a step in a supersonic combustor [AIAA PAPER 74-1161] A75-10317
- SUPERSONIC FLIGHT**
Acoustics of the sonic boom --- Book A75-13023
- SUPERSONIC FLOW**
A difference method for axisymmetric supersonic flow in rotating annular cascades with local subsonic regions A75-11045
Pressure distribution on two wings with curved leading edges at supersonic speeds [ARC-R/M-3741] A75-10028
- SUPERSONIC INLETS**
The application of boundary layer suction to suppress strong shock-induced separation in supersonic inlets [AIAA PAPER 74-1063] A75-10257
Inlet development for the B-1 strategic bomber [AIAA PAPER 74-1064] A75-10258
Variable geometry for supersonic mixed-compression inlets [AIAA PAPER 74-1172] A75-10322
- Development and experimental verification of a technique to test full-scale inlet/engine systems at maneuvering conditions [AIAA PAPER 74-1199] A75-10344
Flight-test techniques for obtaining valid comparisons of wind-tunnel and flight results from tests on a YF-12 mixed-compression inlet [AIAA PAPER 74-1195] A75-11301
- SUPERSONIC SPEEDS**
A study of the damping characteristics on models of supersonic air lines at supersonic speeds [AD-784259] A75-10077
- SUPERSONIC TRANSPORTS**
Atmospheric ozone and its influence on the operation of supersonic transport A75-11639
A study of the damping characteristics on models of supersonic air lines at supersonic speeds [AD-784259] A75-10077
Advanced supersonic technology concept study: Hydrogen fueled configuration [NASA-CR-114718] A75-10943
- SUPERSONIC TURBINES**
Small turbine engine technology [AIAA PAPER 74-1184] A75-10333
- SUPPORTS**
HLH/ATC engine shaft support bearing development program [AD-784593] A75-10097
- SURFACE GEOMETRY**
A parametric study of effect of forebody shape on flow angularity at Mach 8 --- for hypersonic aircraft [NASA-TN-D-7768] A75-10008
- SURFACE PROPERTIES**
A case study of ultra high rate of wear experienced in a gear tooth flank [ASLE PREPRINT 74LC-6B-2] A75-12188
- SURFACE TO AIR MISSILES**
The development of an accurate aerodynamic simulation model for the SAM-D missile with a relatively small computer storage requirement A75-10414
- SWEEP FORWARD WINGS**
Static aeroelasticity and the flying wing, revisited A75-12622
- SWEEP WINGS**
A calculation method for the turbulent boundary layer on an infinite yawed wing in compressible, adiabatic flow [ARC-CP-1268] A75-10024
A viscous/potential flow interaction analysis method for multi-element infinite swept wings, volume 1 [NASA-CR-2476] A75-10358
- SWEEPBACK WINGS**
Interference of a sweepback wing and the fuselage at transonic speeds [NASA-TT-P-15993] A75-10056
- SWIRLING**
Influence of swirling flow on heat transfer in nozzles A75-10204
- SYNCHRONOUS MOTORS**
Number of bars and torque of squirrel cage rotors --- for an asynchronous motor [RAE-LIB-TRANS-1781] A75-11154
- SYSTEMS ENGINEERING**
Application of methods of abstract algebra to the synthesis of an automatic system for controlling the longitudinal motion of an aircraft A75-11121
T and E guidelines for aircraft systems [AD-784549] A75-10085

T

T TAIL SURFACES

- Variational-difference method of studying the stressed state of the rim of the turbine disk in a T-shaped tail joint A75-11235

T-28 AIRCRAFT

- Development of an armored T-28 aircraft for probing hailstorms A75-10638

SUBJECT INDEX

THRUST MEASUREMENT

TAIL ASSEMBLIES

Analysis of multihinge tailplane with account for control surface deflection A75-12088

Elastic pitch beam tail rotor operational suitability investigation [AD-784595] N75-10069

TAKEOFF RUNS

Steam rockets for takeoff A75-11373

TARGET ACQUISITION

Helicopter dropsight [AD-784551] N75-10084
Resistance of radar systems against interference N75-11797

TARGET DRONE AIRCRAFT

Expendable solid propellant boost motors for small target aircraft [AIAA PAPER 74-1125] A75-10292

TECHNOLOGICAL FORECASTING

Next generation transports will emphasize fuel savings A75-11426
Fuel outlook dictating technical transport research A75-11427

Flight management - Pilot procedures and system interfaces for the 1980-1990's [AIAA PAPER 74-1297] A75-12248

TECHNOLOGY ASSESSMENT

Drone/RPV systems --- Remotely Piloted Vehicle as weapon system A75-10186

Small flying engines are different --- aircraft gas turbine design [AIAA PAPER 74-1185] A75-10334
Sealing technology for aircraft gas turbine engines [AIAA PAPER 74-1188] A75-10336
State of radome technology - 1974; Proceedings of the Twelfth Symposium on Electromagnetic Windows, Georgia Institute of Technology, Atlanta, Ga., June 12-14, 1974 A75-10851

LTA in the USA - Here's where it stands today --- lighter than air vehicles [AIAA PAPER 74-1280] A75-11116

Automated structural design with aeroelastic constraints - A review and assessment of the state of the art A75-11624

Materials on the move; Proceedings of the Sixth National Technical Conference, Dayton, Ohio, October 8-10, 1974 A75-13028

Improved primer coating systems for the transportation industries A75-13043

TECHNOLOGY UTILIZATION

Laminated metallic structure - Advanced applications A75-13046

TELEPHOTOMETRY

Preliminary test results of the 'oblique ray' installation --- for atmospheric light transmission A75-11641

TELEVISION SYSTEMS

An exploratory flight investigation of helicopter sling-load placements using a closed-circuit television as a pilot aid [NASA-TN-D-7776] N75-10009

TEMPERATURE DISTRIBUTION

Radio frequency heating of radomes in an aerodynamic environment A75-10876

TERMINAL BALLISTICS

Experimental hydraulic ram studies (FY 74) [AD-784736] N75-11230

TERMINAL FACILITIES

Flight demonstration of the feasibility of a scanning beam microwave landing system N75-10919

TEST EQUIPMENT

T and E guidelines for airborne ECM systems [AD-784574] N75-10332

TEST FACILITIES

NASA-Langley helicopter tower instrumentation systems [NASA-CR-132522] N75-10106

TF-30 ENGINE

Real-time simulation of the TF30-P-3 turbofan engine using a hybrid computer [NASA-TN-X-3106] N75-10095

THERMAL BOUNDARY LAYER

EM window thermal barriers --- on supersonic aircraft A75-10857

THERMAL FATIGUE

Low cycle high temperature fatigue --- in aircraft jet engines: conference proceedings [AGARD-CP-155] N75-10487
Precision in LCHTF testing --- of aircraft jet engines N75-10490

The effect of cycle parameters on high temperature low cycle fatigue --- in aircraft jet engines N75-10491

Lifetime prediction methods for elevated temperature fatigue --- in aircraft jet engines N75-10493

Design procedures for elevated temperature low-cycle fatigue --- as applied to aircraft jet engines N75-10494

THERMAL PROTECTION

EM window thermal barriers --- on supersonic aircraft A75-10857

THERMAL RESISTANCE

Polyimide materials development for high temperature, broadband radome applications A75-10872

Oxide dispersion strengthened alloys for aircraft turbine engine vanes A75-13040

THERMAL STRESSES

Applications of similarity laws in the case of turbomachines A75-11674

THERMOPLASTIC RESINS

Thermal plastic radomes A75-10880

THIN AIRFOILS

Comment on 'Investigation of multi-element airfoils with external flow jet flap' by F. Mavriplis A75-11084

THIN WINGS

Calculation of the aerodynamic characteristics of a system of rectangular wings moving near a screening surface A75-12078

THREE DIMENSIONAL COMPOSITES

A rain erosion evaluation of three-dimensional woven silica and reaction sintered silicon nitride as state-of-the-art radome materials A75-10875

THREE DIMENSIONAL FLOW

The problem of three-dimensional lifting potential flow and its solution by means of surface singularity distribution A75-12345

THRUST AUGMENTATION

Oscillating jet nozzles for V/STOL application [AIAA PAPER 74-1189] A75-10337

An analytic description of hypermixing and test of an improved nozzle [AIAA PAPER 74-1190] A75-10338

A computer program for aircraft thrust ejector analyses [AIAA PAPER 74-1191] A75-10339

Ejector thrust augmentation for STOL aircraft applications [AIAA PAPER 74-1192] A75-10340

THRUST CONTROL

Powerplant energy management --- transport aircraft engine thrust control [AIAA PAPER 74-1066] A75-10259

THRUST MEASUREMENT

Recent flight experience with the F100 engine in the YF-16 [AIAA PAPER 74-1163] A75-11298
A new jet engine thrust measuring system: An advancement in flight test engineering N75-10922

THRUST REVERSAL

- Test and evaluation of a fighter aircraft in-flight thrust reverser [AIAA PAPER 74-1170] A75-10321
 - Performance of a model cascade thrust reverser for short-haul applications [AIAA PAPER 74-1171] A75-11299
 - Noise of model target type thrust reversers for engine-over-the-wing applications [NASA-TM-X-71621] N75-10948
- THRUST VECTOR CONTROL**
- V/STOL deflector concepts [AIAA PAPER 74-1168] A75-10319
- TIME LAG**
- Stabilization of the longitudinal motion of a flight vehicle in the presence of a delay in the control forces A75-11653

TITANIUM ALLOYS

- Weldability and quality of titanium alloy weldments A75-13044

TORQUE

- Number of bars and torque of squirrel cage rotors --- for an asynchronous motor [RAE-LIB-TRANS-1781] N75-11154

TOWERS

- NASA-Langley helicopter tower instrumentation systems [NASA-CR-132522] N75-10106

TRACE CONTAMINANTS

- The 1973 program of measurement of the minor constituents of the stratosphere using the Concorde 001 A75-11720

TRADEOFFS

- Resolving the contradictions between airplane component weight and drag A75-12077

TRAINING DEVICES

- Flight fidelity testing of US Navy operational flight trainers N75-10915

TRANSONIC FLIGHT

- A flow field model for, and some studies on the drag of, an engine exhaust system at transonic flight speeds [AIAA PAPER 74-1175] A75-10325
- Development and experimental verification of a technique to test full-scale inlet/engine systems at maneuvering conditions [AIAA PAPER 74-1199] A75-10344
- Interference of a sweptback wing and the fuselage at transonic speeds [NASA-TT-P-15993] N75-10056

TRANSONIC FLOW

- Two dimensional transonic two-phase flow in axisymmetric nozzles [AIAA PAPER 74-1088] A75-10275
- Variable geometry for supersonic mixed-compression inlets [AIAA PAPER 74-1172] A75-10322
- An extension of the 'parabolic method' to the calculation of transonic flows A75-10837
- Low-frequency three-dimensional profile vibrations in transonic gas flow A75-13132

TRANSONIC SPEED

- Measurement of pitching moment on an oscillating rectangular wing at transonic speeds using the resonance method A75-12829

TRANSPARENCY

- Polycarbonate aircraft transparencies A75-13041

TRANSPORT AIRCRAFT

- Powerplant energy management --- transport aircraft engine thrust control [AIAA PAPER 74-1066] A75-10259
- Electronic propulsion controls for commercial aircraft [AIAA PAPER 74-1065] A75-11280
- Next generation transports will emphasize fuel savings A75-11426
- Fuel outlook dictating technical transport research A75-11427
- Design objectives - Air transportation A75-13029

- Operational effectiveness of transport aircraft [NASA-TT-P-810] N75-10036

- A comparison of optimum JP and LH2 turbofan engines designed for two subsonic transport missions [NASA-TM-X-71622] N75-10945

TURBINE ENGINES

- Pretting in aircraft turbine engines A75-10925
- Improved reliability of turbine engines through common sense maintenance A75-11087
- The American STAGG gas generator program A75-11721
- Oxide dispersion strengthened alloys for aircraft turbine engine vanes A75-13040

TURBINE WHEELS

- Variational-difference method of studying the stressed state of the rim of the turbine disk in a T-shaped tail joint A75-11235

TURBOCOMPRESSORS

- Effect of erosive wear on aircraft gas turbine engine axial compressor cantilever blade endurance A75-12106
- Transonic compressor technology advancements N75-11199

TURBOFAN ENGINES

- Turbofan noise reduction using a near sonic inlet [AIAA PAPER 74-1098] A75-10281
- A test cell engine diagnostic system - From research to reality [AIAA PAPER 74-1207] A75-10349
- Gas turbine engines - A state-of-the-art review A75-10840
- F-15 flight test experience with the F100-PW-100 engine [AIAA PAPER 74-1162] A75-11297
- Design objectives - Air transportation A75-13029

- A comparison of optimum JP and LH2 turbofan engines designed for two subsonic transport missions [NASA-TM-X-71622] N75-10945

TURBOFANS

- Two-stage fan. 2: Data and performance with redesigned second stage rotor uniform and distorted inlet flows [NASA-CR-134710] N75-10944

TURBOJET ENGINES

- Viper turbojet engines. II --- design and applications A75-11371
- An inexpensive jet engine, dream or reality --- for remotely piloted vehicles A75-11724

- Effect of erosive wear on aircraft gas turbine engine axial compressor cantilever blade endurance A75-12106
- Teledyne aims at low-cost engines A75-12722

TURBOMACHINERY

- Applications of similarity laws in the case of turbomachines A75-11674

TURBOPROP AIRCRAFT

- Short SD3-30 --- twin turboprop commuter aircraft with wide body design A75-12420

TURBOPROP ENGINES

- Gas turbine engines - A state-of-the-art review A75-10840

TURBOSHAPTS

- The Detroit Diesel Allison Model 250-C28 turboshaft engine [AIAA PAPER 74-1186] A75-10335
- Gas turbine engines - A state-of-the-art review A75-10840

TURBULENCE EFFECTS

- Influence of inherent carrier motion on a frequency selection system A75-12060
- Critical review of methods to predict the buffet capability of aircraft [AGARD-R-623] N75-10053
- Results of full-scale vortex attenuation flight experiments N75-10931

SUBJECT INDEX

VORTICES

TURBULENT BOUNDARY LAYER

A calculation method for the turbulent boundary layer on an infinite yaved wing in compressible, adiabatic flow
[ARC-CP-1268] N75-10024

TURBULENT FLOW

A calculation method for the two dimensional turbulent flow over a slotted flap
[ARC-CP-1267] N75-10023

Isolated rotor noise due to inlet distortion or turbulence
[NASA-CR-2479] N75-10094

TURBULENT HEAT TRANSFER

Influence of swirling flow on heat transfer in nozzles
A75-10204

TURBULENT WAKES

Monitoring the Movement of wake vortices at Kennedy and Stapleton Airports
N75-10929

Hot-wire anemometry for in-flight measurement of aircraft wake vortices
N75-10930

TWO DIMENSIONAL BOUNDARY LAYER

Turbulent mean velocity measurements on a rotating cone
A75-10043

TWO DIMENSIONAL FLOW

Two dimensional transonic two-phase flow in axisymmetric nozzles
[AIAA PAPER 74-1088] A75-10275

A calculation method for the two dimensional turbulent flow over a slotted flap
[ARC-CP-1267] N75-10023

TWO PHASE FLOW

Two dimensional transonic two-phase flow in axisymmetric nozzles
[AIAA PAPER 74-1088] A75-10275

U

UH-1 HELICOPTER

Endurance testing of an LM-726-4 elastomeric pitch change bearing
[AD-784140] N75-10074

Interservice utility helicopter reliability and maintainability comparative analysis
[AD-784177] N75-10080

Helicopter droopsight
[AD-784551] N75-10084

ULTRASONIC TESTS

Automated computerized ultrasonic rating system provides new level of design confidence
A75-12931

A computer automated ultrasonic inspection system for aircraft forgings
A75-12933

V

V/STOL AIRCRAFT

V/STOL deflector concepts
[AIAA PAPER 74-1168] A75-10319

Exhaust nozzle deflector systems for V/STOL fighter aircraft
[AIAA PAPER 74-1169] A75-10320

Oscillating jet nozzles for V/STOL application
[AIAA PAPER 74-1189] A75-10337

Ground effect for V/STOL aircraft configurations and its simulation in the wind tunnel. Part 3: The tangentially blown ground as an alternative to a moving ground: Application to the NASA-Ames 40 by 80-foot wind tunnel
[NASA-CR-114497] N75-10005

Optimal control theory investigation of propotor/wing response to vertical gust
[NASA-TM-X-62384] N75-10057

Reliability of laboratory tests of VSTOL and other long duration noises
[NASA-CR-2471] N75-10093

Experience with the NRC 10 feet by 20 feet V/STOL propulsion tunnel: Some practical aspects of V/STOL engine model testing
[DME/NAE-1973 (2)] N75-10107

VANES

Oxide dispersion strengthened alloys for aircraft turbine engine vanes
A75-13040

VARIABLE GEOMETRY STRUCTURES

Variable geometry for supersonic mixed-compression inlets
[AIAA PAPER 74-1172] A75-10322

VARIATIONAL PRINCIPLES

A conceptual approach to applying singular perturbation methods to variational problems --- in optimal control
A75-11895

VEHICULAR TRACKS

A wind energy conversion system based on the tracked-vehicle airfoil concept
A75-10518

VELOCITY MEASUREMENT

Turbulent mean velocity measurements on a rotating cone
A75-10043

Measurement of model helicopter rotor flow velocities with a laser Doppler velocimeter
A75-10839

VERTICAL AIR CURRENTS

Optimal control theory investigation of propotor/wing response to vertical gust
[NASA-TM-X-62384] N75-10057

VERTICAL TAKEOFF AIRCRAFT

Prediction of ground effects for VTOL aircraft with twin lifting jets
[AIAA PAPER 74-1167] A75-10318

Optimum transient response characteristic of a VTOL aircraft with direct side force control --- jet control for optimization of VTOL aircraft flight characteristics
[DLB-FB-73-72] N75-10103

VIBRATION DAMPING

Techniques for improving the stability of soft inplane hingeless rotors
[NASA-TM-X-62390] N75-10058

VIBRATION MODE

Low-frequency three-dimensional profile vibrations in transonic gas flow
A75-13132

VIBRATION TESTS

Stress and vibration analysis with the aid of models; Meeting, Stuttgart, West Germany, October 4, 5, 1973, Reports
A75-11672

Investigations involving a 'dynamically similar' component model of the VFW 614 - Experimental determination of the fundamental oscillation parameters
A75-11673

Vibrational investigations on aircraft models in support of flutter calculations
A75-11676

Determination of the dynamic characteristics of a structure from a vibration test performed with only one excitation point --- exemplified for aircraft structures
N75-10371

Application of the fast Fourier transform to ground vibration testing, and flight flutter testing
N75-10926

VISCOSITY

Roll-up of aircraft trailing vortices using artificial viscosity
A75-12620

VISCOUS FLOW

The stability of a trailing line vortex. II - Viscous theory
A75-10621

The nature, development and effect of the viscous flow around an aerofoil with high-lift devices
[ARC-CP-1258] N75-10021

A viscous/potential flow interaction analysis method for multi-element infinite swept wings, volume 1
[NASA-CR-2476] N75-10358

VORTEX BREAKDOWN

Correlation for estimating vortex rotational velocity downstream dependence
A75-12621

Results of full-scale vortex attenuation flight experiments
N75-10931

VORTICES

An analytic description of hypermixing and test of an improved nozzle
[AIAA PAPER 74-1190] A75-10338

- The stability of a trailing line vortex. II -
Viscous theory A75-10621
- Calculation of the aerodynamic characteristics of
a system of rectangular wings moving near a
screening surface A75-12078
- Roll-up of aircraft trailing vortices using
artificial viscosity A75-12620
- Monitoring the Movement of wake vortices at
Kennedy and Stapleton Airports N75-10929
- Hot-wire anemometry for in-flight measurement of
aircraft wake vortices N75-10930
- Results of full-scale vortex attenuation flight
experiments N75-10931

VORTICITY

- The problem of three-dimensional lifting potential
flow and its solution by means of surface
singularity distribution A75-12345

W**WARPAGE**

- The design of a series of warped slender wings for
subsonic speeds [ARC-CP-1263] N75-10022

WATER EROSION

- A rain erosion evaluation of three-dimensional
woven silica and reaction sintered silicon
nitride as state-of-the-art radome materials A75-10875

WEAPON SYSTEMS

- Head-up display optics --- application to weapon
aiming systems in military aircraft N75-10780
- The R and D simulator: A new T and E tool ---
application of simulators for research and
development of aircraft systems N75-10914
- Flight testing the F-15/AIM-7F weapon delivery mode
N75-10918

WEAPONS DEVELOPMENT

- The R and D simulator: A new T and E tool ---
application of simulators for research and
development of aircraft systems N75-10914

WEAR

- Effect of erosive wear on aircraft gas turbine
engine axial compressor cantilever blade endurance
A75-12106

WEAR INHIBITORS

- Pretting in aircraft turbine engines A75-10925

WEAR TESTS

- A case study of ultra high rate of wear
experienced in a gear tooth flank
[ASLE PREPRINT 74LC-6B-2] A75-12188
- Lubricity of jet A-1 and JP-4 fuels --- as
indicated by wear friction [AD-784772] N75-11115

WEIGHT ANALYSIS

- Rationale for cost-weight analysis --- in airframe
design [AIAA PAPER 74-961] A75-13069

WEIGHT REDUCTION

- Applications of graphite and aramid composites on
the YF-17 prototype fighter A75-13047

WELDABILITY

- Weldability and quality of titanium alloy weldments
A75-13044

WELDED STRUCTURES

- Weldability and quality of titanium alloy weldments
A75-13044

WIND TUNNEL MODELS

- A test technique for inlet/aircraft drag evaluation
[AIAA PAPER 74-1145] A75-10306
- Measurement of model helicopter rotor flow
velocities with a laser Doppler velocimeter
A75-10839
- A study of the damping characteristics on models
of supersonic air lines at supersonic speeds
[AD-784259] N75-10077

WIND TUNNEL TESTS

- Ejector thrust augmentation for STOL aircraft
applications [AIAA PAPER 74-1192] A75-10340
- Development and experimental verification of a
technique to test full-scale inlet/engine
systems at maneuvering conditions [AIAA PAPER 74-1199] A75-10344
- Aerodynamic torques on rotating oblate spheroids
A75-11151
- Flight-test techniques for obtaining valid
comparisons of wind-tunnel and flight results
from tests on a YF-12 mixed-compression inlet
[AIAA PAPER 74-1195] A75-11301
- Applied aerodynamics --- Russian book on
experimental methods, measurement and
calculation techniques A75-13026

- Wind tunnel tests of modified cross, hemisflo, and
disk-gap-band parachutes with emphasis in the
transonic range [NASA-TN-D-7759] N75-10007
- Results of a series of wind tunnel tests on the
victor B.Mk.2 aircraft and a comparison with
drag estimates and full scale flight data.
[ARC-CP-1283] N75-10026

- Experience with the NRC 10 feet by 20 feet V/STOL
propulsion tunnel: Some practical aspects of
V/STOL engine model testing [DME/NAE-1973 (2)] N75-10107

WINDOWS

- State of radome technology - 1974; Proceedings of
the Twelfth Symposium on Electromagnetic
Windows, Georgia Institute of Technology,
Atlanta, Ga., June 12-14, 1974 A75-10851

WINDPOWERED GENERATORS

- A wind energy conversion system based on the
tracked-vehicle airfoil concept A75-10518

WING FLAPS

- Loadings and flight limitations of the sailplane
having the speed flap. I A75-10721
- The externally-blown jet flap - A powered-lift
concept for STOL A75-11085

- Roll-up of aircraft trailing vortices using
artificial viscosity A75-12620
- A calculation method for the two dimensional
turbulent flow over a slotted flap
[ARC-CP-1267] N75-10023

WING FLOW METHOD TESTS

- Correlation for estimating vortex rotational
velocity downstream dependence A75-12621

- Applied aerodynamics --- Russian book on
experimental methods, measurement and
calculation techniques A75-13026

WING LOADING

- Some remarks on the solution of the lifting line
equation A75-11095
- Static aeroelasticity and the flying wing, revisited
A75-12622

WING OSCILLATIONS

- Measurement of pitching moment on an oscillating
rectangular wing at transonic speeds using the
resonance method A75-12829
- Lifting surface theory applied to fixed wings and
propellers N75-10016

WING PLANFORMS

- Application of the polar coordinate method to
oscillating wing configurations [SAAB-TN-69] N75-10010

WING PROFILES

- The problem of three-dimensional lifting potential
flow and its solution by means of surface
singularity distribution A75-12345
- Some problems of the canard configuration. I
A75-12473
- Kasprzyk's revelatory wing --- for gliders
A75-12474

SUBJECT INDEX

YF-16 AIRCRAFT

Generation of aerodynamic profiles and
establishing the circulation around a wing by
deformation of the wing . A75-12638

Noise of model target type thrust reversers for
engine-over-the-wing applications
[NASA-TM-X-71621] N75-10948

WING TIPS
Results of full-scale vortex attenuation flight
experiments N75-10931

A passive wingtip load alleviation system
[NASA-CR-140758] N75-10937

WINGS
Comparison of the acoustic characteristics of
large-scale models of several propulsive-lift
concepts
[AIAA PAPER 74-1094] A75-10278

WROUGHT ALLOYS
Evaluating new aluminum forging alloys A75-12729

Y

YAW
A calculation method for the turbulent boundary
layer on an infinite yawed wing in compressible,
adiabatic flow
[ARC-CP-1268] N75-10024

YC-14 AIRCRAFT
YC-14 system for leading edge boundary layer control
[AIAA PAPER 74-1278] A75-11115

YF-16 AIRCRAFT
YF-16 could advance air combat tactics A75-10017

YF-16 inlet design and performance
[AIAA PAPER 74-1062] A75-11279

Recent flight experience with the F100 engine in
the YF-16
[AIAA PAPER 74-1163] A75-11298

Installation benefits of the single-engine exhaust
nozzle on the YF-16
[AIAA PAPER 74-1101] A75-12571

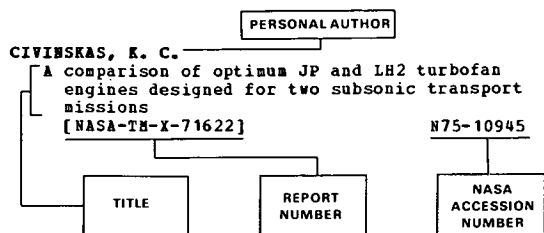
Fly-by-wire is here --- fighter aircraft flight
control A75-12825

PERSONAL AUTHOR INDEX

AERONAUTICAL ENGINEERING /A Special Bibliography (Suppl. 54)

FEBRUARY 1975

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The accession number is located beneath and to the right of the title, e.g. N75-10019. Under any one author's name the accession numbers are arranged in sequence with the /AA accession numbers appearing first.

A

- ACKERMAN, M.**
The 1973 program of measurement of the minor constituents of the stratosphere using the Concorde 001
A75-11720
- ADGAMOV, R. I.**
Optimization of automated static tests of gas turbine engines
A75-12332
- AGGARWAL, R.**
A conceptual approach to applying singular perturbation methods to variational problems
A75-11895
- AIKEN, T. M.**
Comparison of the acoustic characteristics of large-scale models of several propulsive-lift concepts
[AIAA PAPER 74-1094]
A75-10278
- ALEXANDER, W. C.**
Wind tunnel tests of modified cross, hemisflo, and disk-gap-band parachutes with emphasis in the transonic range
[NASA-TN-D-7759]
N75-10007
- ALGERMISSEN, J.**
Performance limitation of a hypersonic ramjet engine due to reaction kinetics
A75-11046
- ALLISON, J. E.**
A computer automated ultrasonic inspection system for aircraft forgings
A75-12933
- ALLISON, J. W.**
Aids - Expectations past, present and future
[AIAA PAPER 74-1067]
A75-10260
- AMASON, M. P.**
Lightning protection for advanced aircraft radomes based on the segmented lightning diverter strip
A75-10877
- ANANYEV, I. V.**
Tabulated values of combinations of cyclic and hyperbolic functions
N75-10052
- ANDREONE, V. M.**
Doppler radar boast design innovations
A75-10625
- ANGELUS, P.**
A new look at qualification of aircraft equipment
A75-12122

- AOYAGI, K.**
Comparison of the acoustic characteristics of large-scale models of several propulsive-lift concepts
[AIAA PAPER 74-1094]
A75-10278
- ARNALIZ, H.**
Flight-test techniques for obtaining valid comparisons of wind-tunnel and flight results from tests on a YF-12 mixed-compression inlet
[AIAA PAPER 74-1195]
A75-11301
- ASHILL, P. R.**
The nature, development and effect of the viscous flow around an aerofoil with high-lift devices
[ARC-CP-1258]
N75-10021
- ASHLEY, H.**
Static aeroelasticity and the flying wing, revisited
A75-12622
- ASHTON, L. J.**
Structural advances in helicopter rotor blade technology
A75-13045
- ASIALA, C. P.**
High acceleration cockpits for advanced fighter aircraft. Volume 3: Test plan
[AD-783602]
N75-10066
- High acceleration cockpits for advanced fighter aircraft. Volume 4: Test results**
[AD-783603]
N75-10067
- ATALLAH, S.**
Evaluation of auxiliary agents and systems for aircraft ground fire suppression, phase 2
[AD-784924]
N75-10957
- AVERTY, D. E.**
Operating experiences of retardant bombers during firefighting operations
[NASA-TN-X-72622]
N75-10934
- AZUMA, A.**
Pitch damping of helicopter rotor with nonuniform inflow
A75-11094

B

- BAGLEY, R.**
Model 301 HLH/ATC (Heavy Lift Helicopter/Advanced Technology Component) transmission noise reduction program
[AD-784132]
N75-10063
- BAILEY, C. D.**
From creaking cracks to breaking beams - A review of acoustic emission for aircraft structure
A75-13035
- BAILEY, P. G.**
Oxide dispersion strengthened alloys for aircraft turbine engine vanes
A75-13040
- BALDOCK, J. C. A.**
Some calculations for air resonance of a helicopter with non-articulated rotor blades
[ARC-R/M-3743]
N75-10029
- BALL, W. H.**
Rapid calculation of propulsion system installation corrections
[AIAA PAPER 74-1174]
A75-10324
- BALLARD, G.**
F-15 flight test experience with the F100-PW-100 engine
[AIAA PAPER 74-1162]
A75-11297
- BASSETT, H. L.**
Anisotropic dielectric panel analysis
A75-10859
- BATES, C. N.**
Doppler radar boast design innovations
A75-10625

- BATT, D. L.
A study on aircraft map display location and orientation
A75-12725
- BEAN, E. C.
A prototype four-horn cluster IPF antenna
[AD-784395] N75-10327
- BEHEIN, H. A.
Design objectives - Air transportation
A75-13029
- BELL, B., JR.
High-performance hydraulic system powers aircraft simulator
A75-10426
- BENSER, W. A.
Transonic compressor technology advancements
N75-11199
- BENSTEIN, E. H.
Small flying engines are different
[AIAA PAPER 74-1185] A75-10334
- BERA, R. K.
Some remarks on the solution of the lifting line equation
A75-11095
- BERKSTRESSER, B. K.
Avionics systems in the management of air transportation
[AIAA PAPER 74-1294] A75-12246
- BEVILACQUA, P. M.
An analytic description of hypermixing and test of an improved nozzle
[AIAA PAPER 74-1190] A75-10338
- BIALA, B.
Loadings and flight limitations of the sailplane having the speed flap. I
A75-10721
- BIKCHANTAEV, M. KH.
Optimization of automated static tests of gas turbine engines
A75-12332
- BILL, R. C.
Fretting in aircraft turbine engines
A75-10925
- BIRD, W. H. S.
Noise and atmospheric emissions - An airline view
A75-11083
- BISHOP, E. H.
A wind energy conversion system based on the tracked-vehicle airfoil concept
A75-10518
- BITTRICK, W. C.
Installation benefits of the single-engine exhaust nozzle on the YF-16
[AIAA PAPER 74-1101] A75-12571
- BLACKBETTER, D. O.
A wind energy conversion system based on the tracked-vehicle airfoil concept
A75-10518
- BLACKWELL, R. H.
Investigation of the effects of blade structural design parameters on helicopter stall boundaries
[AD-784594] N75-10075
- BLOOM, A. M.
Roll-up of aircraft trailing vortices using artificial viscosity
A75-12620
- BODMER, A.
The American SPAGG gas generator program
A75-11721
- BODNAR, D. G.
Anisotropic dielectric panel analysis
A75-10859
- BOROVSKII, E. E.
Applied aerodynamics
A75-13026
- BOWER, W. W.
An analytical procedure for the calculation of attached and separated subsonic diffuser flows
[AIAA PAPER 74-1173] A75-10323
- BRENT, J. A.
Single-stage experimental evaluation of tandem-airfoil rotor and stator blading for compressors, part 8
[NASA-CR-134713] N75-10947
- BREWER, G. D.
Advanced supersonic technology concept study: Hydrogen fueled configuration
[NASA-CR-114718] N75-10943
- BRODNAY, C. T.
A conceptual definition study for a digital avionics information system (approach 2), volume 1
[AD-780581/5] N75-10071
- A conceptual definition study for a digital avionics information system (approach 2). Volume 2: Appendixes A thru D
[AD-780582/3] N75-10072
- BRUTON, W. M.
Real-time simulation of the TF30-P-3 turbofan engine using a hybrid computer
[NASA-TM-X-3106] N75-10095
- C**
- CALDWELL, E. O.
Ground effect for V/STOL aircraft configurations and its simulation in the wind tunnel. Part 3: The tangentially blown ground as an alternative to a moving ground: Application to the NASA-Ames 40 by 80-foot wind tunnel
[NASA-CR-114497] N75-10005
- CALISE, A. J.
A conceptual approach to applying singular perturbation methods to variational problems
A75-11895
- CAMERON, J. M.
Flow immediately behind a step in a supersonic combustor
[AIAA PAPER 74-1161] A75-10317
- CAMPAGNA, A. W.
A study of stabilization techniques for small, fixed-wing, remotely piloted aircraft
[AD-784109] N75-10079
- CAMPBELL, G. S.
A response criterion for aircraft with fly-by-wire control systems
A75-10018
- CARBONE, H. M.
Studies of slurry fueled propulsion systems
[AD-784362] N75-11114
- CARTER, C. J.
Automated computerized ultrasonic rating system provides new level of design confidence
A75-12931
- CELLITTI, R. A.
Automated computerized ultrasonic rating system provides new level of design confidence
A75-12931
- CHABOT, L.
Airborne testing of advanced multisensor aircraft
N75-10921
- CHAMPINE, R. A.
Results of full-scale vortex attenuation flight experiments
N75-10931
- CHEESEMAN, I. C.
Helicopter - People and places /14th Cierva Memorial Lecture/
A75-10187
- CHERTKOV, I. A. B.
The use of jet fuels in aviation
A75-13000
- CHICARELLO, P. J.
Fire protection of large Air Force hangars
[AD-784869] N75-10961
- CHIKHLADZE, T. M.
Stabilization of the longitudinal motion of a flight vehicle in the presence of a delay in the control forces
A75-11653
- CHISOLM, C. E.
Flight testing the F-15/AIH-7F weapon delivery mode
N75-10918
- CHORLEY, R. A.
Head-up display optics
N75-10780
- CHRISTOPHER, A. J.
Emission of smoke and fumes at temperatures up to 500 C
A75-10799
- CIPFONE, D. L.
Correlation for estimating vortex rotational velocity downstream dependence
A75-12621
- CISKOWSKI, T. M.
Turbofan noise reduction using a near sonic inlet
[AIAA PAPER 74-1098] A75-10281

PERSONAL AUTHOR INDEX

ERLICH, E.

CIVINSKAS, K. C.
A comparison of optimum JP and LH2 turbofan engines designed for two subsonic transport missions
[NASA-TM-X-71622] N75-10945

CLARK, F.
Elastic pitch beam tail rotor operational suitability investigation
[AD-784595] N75-10069

CLARK, L. T.
Statistical averages of subsonic inlet distortion
[AIAA PAPER 74-1197] A75-10342

CLARKE, G. E.
High sink-rate landing testing of Navy aircraft
N75-10924

CLAY, L. E.
Statistical analysis of general aviation VG-VGH data
[NASA-CR-132531] N75-10933

CLEMMONS, D. R.
Single-stage experimental evaluation of tandem-airfoil rotor and stator blading for compressors, part 8
[NASA-CR-134713] N75-10947

CLICK, H. F., JR.
Applications of graphite and aramid composites on the YF-17 prototype fighter
A75-13047

COCKCROFT, M. G.
The effect of cycle parameters on high temperature low cycle fatigue
N75-10491

COLLINS, J. A.
Development of accelerated life testing techniques for general failure modes of aircraft hardware
[AD-784188] N75-10073

CONNERFORD, G. L.
Investigation of the effects of blade structural design parameters on helicopter stall boundaries
[AD-784594] N75-10075

COMPTON, P. V.
Skid resistance tests in support of the F-4 rain tire program at the Air Force Flight Test Center
[AD-784801] N75-10958

CONNELLY, J. J.
Automated computerized ultrasonic rating system provides new level of design confidence
A75-12931

COOKE, M.
Automatic flying of curved approach paths: A computer and flight investigation
[RAE-TR-73154] N75-10043

COWLEY, P. R.
Improved reliability of turbine engines through common sense maintenance
A75-11087

CRAIG, R. P.
Optimum rate of climb for high performance aircraft
[AD-784112] N75-10076

CRANE, L. J.
Axial flow past a cylinder with suction
A75-10140

CROSBY, S. R.
Lifetime prediction methods for elevated temperature fatigue
N75-10493

D

DALAL, R. P.
Development of high strength cast superalloys with hot corrosion resistance
A75-13039

DANILOV, A. N.
Applied aerodynamics
A75-13026

DAT, R.
Lifting surface theory applied to fixed wings and propellers
N75-10016

Determination of the dynamic characteristics of a structure from a vibration test performed with only one excitation point
N75-10371

DAVIES, P. J.
The design of a series of warped slender wings for subsonic speeds
[ARC-CP-1263] N75-10022

DAVIS, R. T.
Mini-RPV's for cheap and no risk air power
A75-10623

DEANS, A. L.
Expendable solid propellant boost motors for small target aircraft
[AIAA PAPER 74-1125] A75-10292

DEETS, D. A.
A remotely augmented vehicle approach to flight testing RPV control systems
[NASA-TM-X-56029] N75-10936

DELLINGER, E.
Investigations involving a 'dynamically similar' component model of the VPW 614 - Experimental determination of the fundamental oscillation parameters
A75-11673

DEVLIN, B. T.
Automated avionics system checkout and monitoring in a flight test environment
N75-10920

DEYST, J. J.
A passive wingtip load alleviation system
[NASA-CR-140758] N75-10937

DICARLO, D. J.
An exploratory flight investigation of helicopter sling-load placements using a closed-circuit television as a pilot aid
[NASA-TN-D-7776] N75-10009

DICKEY, R. L.
Statistical analysis of general aviation VG-VGH data
[NASA-CR-132531] N75-10933

DICKSON, E. H.
The use of hydrogen in commercial aircraft - An assessment
A75-10542

DIECKMANN, T. W.
Aids - Expectations past, present and future
[AIAA PAPER 74-1067] A75-10260

DIETRICH, D. A.
Performance of a model cascade thrust reverser for short-haul applications
[AIAA PAPER 74-1171] A75-11299

DOBBS, M. E.
Reliability of laboratory tests of VSTOL and other long duration noises
[NASA-CR-2471] N75-10093

DOBSON, M. D.
The external drag of fuselage side intakes: Rectangular intakes with compression surfaces vertical
[ARC-CP-1269] N75-10025

DOVGIALLO, E. N.
Preliminary test results of the 'oblique ray' installation
A75-11641

DVORAK, F. A.
A viscous/potential flow interaction analysis method for multi-element infinite swept wings, volume 1
[NASA-CR-2476] N75-10358

E

EDGINGTON, L. N.
High acceleration cockpits for advanced fighter aircraft. Volume 2: Crew station design/integration
[AD-783601] N75-10065

EDWARDS, J. W.
A remotely augmented vehicle approach to flight testing RPV control systems
[NASA-TM-X-56029] N75-10936

EDWARDS, R. H.
A survey of aircraft noise annoyance in an area of invariant noise to eliminate the effects on annoyance of varying noise exposure
[TT-7405] N75-10755

ELLIS, J. R.
Laminated metallic structure - Advanced applications
A75-13046

EPSTEIN, N.
Powerplant energy management
[AIAA PAPER 74-1066] A75-10259

ERLICH, E.
Methods of visualizing the leading edge separation bubble and analysis of the results
N75-10013

ERMOLENKO, S. D.

- Calculation of the aerodynamic characteristics of a system of rectangular wings moving near a screening surface A75-12078
- ERNST, H. L.
YC-14 system for leading edge boundary layer control [AIAA PAPER 74-1278] A75-11115

F

- FALABSKI, M. D.
Comparison of the acoustic characteristics of large-scale models of several propulsive-lift concepts [AIAA PAPER 74-1094] A75-10278
- FALCONE, A. S.
Elastic pitch beam tail rotor operational suitability investigation [AD-784595] N75-10069
- PARIS, D. W.
Flight demonstration of the feasibility of a scanning beam microwave landing system N75-10919
- FAURY, MR.
An inexpensive jet engine, dream or reality A75-11724
- FEAR, E. J. P.
Emission of smoke and fumes at temperatures up to 500 C A75-10799
- FENNELL, T. R. P. W.
Emission of smoke and fumes at temperatures up to 500 C A75-10799
- FIEDLER, L. J.
Development of high strength cast superalloys with hot corrosion resistance A75-13039
- FIGGE, I. E., SR.
Structural advances in helicopter rotor blade technology A75-13045
- FILIN, V. A.
Influence of swirling flow on heat transfer in nozzles A75-10204
- PINK, D. E.
YP-16 could advance air combat tactics A75-10017
- Shuttle orbiter flight test plan evolves A75-12720
- FITZGERALD, P. M.
Fire protection of large Air Force hangars [AD-784869] N75-10961
- FLESCHER, A.
Weldability and quality of titanium alloy weldments A75-13044
- FONG, C. C.
Improved primer coating systems for the transportation industries A75-13043
- FORTENBAUGH, R. L.
The R and D simulator: A new T and E tool N75-10914
- POSTER, D. W.
The nature, development and effect of the viscous flow around an aerofoil with high-lift devices [ARC-CP-1258] N75-10021
- POUGHNER, J. T., JR.
Wind tunnel tests of modified cross, hemisflo, and disk-gap-band parachutes with emphasis in the transonic range [NASA-TN-D-7759] N75-10007
- POULKE, K. W.
Thermal plastic radomes A75-10880
- FRICK, J. K.
Optimal control theory investigation of propotor/wing response to vertical gust [NASA-TN-X-62384] N75-10057
- FROMMLET, R.
HBB BO 105. II - Concept and worldwide use A75-12525
- FRUEHAUF, H.-H.
A difference method for axisymmetric supersonic flow in rotating annular cascades with local subsonic regions A75-11045

FULLER, H. V.

- A technique for displaying flight information in the field of view of binoculars for use by the pilots of radio controlled models [NASA-TM-X-72015] N75-10786
- FULTON, R. E.
On computer-aided design of aerospace vehicles A75-11626

G

- GALLOWAY, R. T.
Flight fidelity testing of US Navy operational flight trainers N75-10915
- GARZON, J. R.
Turbofan noise reduction using a near sonic inlet [AIAA PAPER 74-1098] A75-10281
- GAUBERT, G.
Analog simulation of the small perturbation equation applied to transonic flows N75-10370
- GENAW, L.
Yaw axis stability augmentation system flight test report [AD-784134] N75-10083
- GOGOLIN, V. P.
Resolving the contradictions between airplane component weight and drag A75-12077
- GOLDSTEIN, S. D.
A rain erosion evaluation of three-dimensional woven silica and reaction sintered silicon nitride as state-of-the-art radome materials A75-10875
- GRADY, H. P.
The LTS 101 600 SHP engine [AIAA PAPER 74-1187] A75-11300
- GRAVELLE, J. A.
A new jet engine thrust measuring system: An advancement in flight test engineering N75-10922
- GRIFFITH, W. E., II
US Army helicopter icing tests N75-10932
- GUPTA, A.
YC-14 system for leading edge boundary layer control [AIAA PAPER 74-1278] A75-11115
- GUSHCHIN, G. P.
Atmospheric ozone and its influence on the operation of supersonic transport A75-11639
- GUTIERREZ, O. A.
Performance of a model cascade thrust reverser for short-haul applications [AIAA PAPER 74-1171] A75-11299
- Noise of model target type thrust reversers for engine-over-the-wing applications [NASA-TM-X-71621] N75-10948

H

- HAAGENSON, W. R.
Inlet development for the B-1 strategic bomber [AIAA PAPER 74-1064] A75-10258
- HACKETT, J. E.
Ground effect for V/STOL aircraft configurations and its simulation in the wind tunnel. Part 3: The tangentially blown ground as an alternative to a moving ground: Application to the NASA-Ames 40 by 80-foot wind tunnel [NASA-CR-114497] N75-10005
- HAGAN, B. T., JR.
Development of accelerated life testing techniques for general failure modes of aircraft hardware [AD-784188] N75-10073
- HALLOCK, J. H.
Monitoring the Movement of wake vortices at Kennedy and Stapleton Airports N75-10929
- HANER, D.
F-15 flight test experience with the F100-PW-100 engine [AIAA PAPER 74-1162] A75-11297
- HANCOCK, D. M.
Recent flight experience with the F100 engine in the YF-16 [AIAA PAPER 74-1163] A75-11298

PERSONAL AUTHOR INDEX

JOHN, H.

- HANKS, M. L.
US Army helicopter icing tests
N75-10932
- HANOVER, C. J.
Electromagnetic compatibility assurance tests for
airborne systems controls in an RF-polluted
environment
[AIAA PAPER 74-1096] A75-10279
- HANSON, P. W.
The prediction of structural response to buffet
flow: A state-of-the-art review
[NASA-TN-X-72627] N75-11372
- HARGETT, E. R.
Evaluation of construction techniques for new
antihydroplaning overlays
[AD-784870] N75-10959
- HARLAN, J. A.
Automated computerized ultrasonic rating system
provides new level of design confidence
A75-12931
- HARLAN, R. B.
A passive wingtip load alleviation system
[NASA-CR-140758] N75-10937
- HARRIS, J. W.
State of radome technology - 1974; Proceedings of
the Twelfth Symposium on Electromagnetic
Windows, Georgia Institute of Technology,
Atlanta, Ga., June 12-14, 1974
A75-10851
- HARRISON, G. P.
The effect of cycle parameters on high temperature
low cycle fatigue
N75-10491
- HARRUFF, P. W.
Polyimide materials development for high
temperature, broadband radome applications
A75-10872
- HARTMAN, R.
Model 301 HLB/ATC (Heavy Lift Helicopter/Advanced
Technology Component) transmission noise
reduction program
[AD-784132] N75-10063
- HASTINGS, E. C., JR.
Results of full-scale vortex attenuation flight
experiments
N75-10931
- HATT, P. G.
Recent flight experience with the F100 engine in
the YF-16
[AIAA PAPER 74-1163] A75-11298
- HAVILL, C. D.
Some factors affecting the use of lighter than air
systems
[NASA-TN-X-62374] N75-10004
- HAWKINS, J. E.
YF-16 inlet design and performance
[AIAA PAPER 74-1062] A75-11279
- HELLYAR, M. W.
The rotor systems research aircraft - A flying
wind tunnel
[AIAA PAPER 74-1277] A75-11114
- HENNEWAY, W. W.
Drone/RPV systems
A75-10186
- HENDERSON, C.
Ejector thrust augmentation for STOL aircraft
applications
[AIAA PAPER 74-1192] A75-10340
- HESS, J. L.
The problem of three-dimensional lifting potential
flow and its solution by means of surface
singularity distribution
A75-12345
- HILL, K. D.
Radio frequency heating of radomes in an
aerodynamic environment
A75-10876
- HINZPETER, U.
Real-time measuring procedure and measuring
equipment for recording the radiation patterns
of aircraft antennas in flight
[ESRO-TT-74] N75-10292
- HIRST, E.
Total energy use for commercial aviation in the US
[ORNL-NSF-EP-68] N75-10039
- HOELZER, C. A.
Test and evaluation of a fighter aircraft
in-flight thrust reverser
[AIAA PAPER 74-1170] A75-10321
- HOPFMAN, D. J.
Interservice utility helicopter reliability and
maintainability comparative analysis
[AD-784177] N75-10080
- HOHENHESER, K. H.
Hingeless rotorcraft flight dynamics
[AGARD-AG-197] N75-10003
- HOOTS, L. C.
Lightning protection for advanced aircraft radomes
based on the segmented lightning diverter strip
A75-10877
- HOWARD, P. W.
Test and evaluation of a fighter aircraft
in-flight thrust reverser
[AIAA PAPER 74-1170] A75-10321
- HUPP, E. M.
A study on aircraft map display location and
orientation
A75-12725
- HUTTENLOCHER, H.
A critique of the F-14A air inlet control system -
From development to production status
[AIAA PAPER 74-1060] A75-11278
- HWANG, C.
Transonic buffet behavior of Northrop F-5A aircraft
[NASA-CR-140939] N75-10054
- I
IAKSHIN, A. P.
Influence of swirling flow on heat transfer in
nozzles
A75-10204
- IKRATH, K.
Interference with aircraft radio navigation and
communications by precipitation static from ice
and snow clouds: Electrostatic wind tunnel
experiments
[AD-784623] N75-10046
- IMFELD, W. F.
The development program for the F-15 inlet
[AIAA PAPER 74-1061] A75-10256
- IRWIN, H. P. A. H.
A calculation method for the two dimensional
turbulent flow over a slotted flap
[ABC-CP-1267] N75-10023
- J
JACOBSEN, R. A.
Hot-wire anemometry for in-flight measurement of
aircraft wake vortices
N75-10930
- JACQUES, L. J.
Two dimensional transonic two-phase flow in
axisymmetric nozzles
[AIAA PAPER 74-1088] A75-10275
- JANTZEN, E.
Investigation and optimization of micro-oxidation
techniques employed in gas turbine engine oil
characterization
[AD-784787] N75-11359
- JEN, H.
Roll-up of aircraft trailing vortices using
artificial viscosity
A75-12620
- JENSEN, R. S.
Uses of a visual landing system in primary flight
training
[AD-784888] N75-10960
- JEWEL, J. W., JR.
Operating experiences of retardant bombers during
firefighting operations
[NASA-TN-X-72622] N75-10934
- JOATTON, R.
The 1973 program of measurement of the minor
constituents of the stratosphere using the
Concorde 001
A75-11720
- JOHANSSON, B. C. A.
Evaluation of the accuracy of two helicopter rotor
theories
[FFA-124] N75-10020
- JOHN, H.
Critical review of methods to predict the buffet
capability of aircraft
[AGARD-R-623] N75-10053

- JOHNSON, B. V.
Measurement of model helicopter rotor flow
velocities with a laser Doppler velocimeter
A75-10839
- JOHNSON, C. B.
A parametric study of effect of forebody shape on
flow angularity at Mach 8
[NASA-TN-D-7768] N75-10008
- JOHNSON, R. L.
Sealing technology for aircraft gas turbine engines
[AIAA PAPER 74-1188] A75-10336
- Pretting in aircraft turbine engines
A75-10925
- JOHNSON, W.
Optimal control theory investigation of
prop rotor/wing response to vertical gust
[NASA-TN-X-62384] N75-10057

K

- KAMBER, P. W.
Electronic propulsion controls for commercial
aircraft
[AIAA PAPER 74-1065] A75-11280
- KAPRALOV, V. M.
Effect of erosive wear on aircraft gas turbine
engine axial compressor cantilever blade endurance
A75-12106
- KEENAN, M. J.
Two-stage fan. 2: Data and performance with
redesigned second stage rotor uniform and
distorted inlet flows
[NASA-CR-134710] N75-10944
- KELLEY, H. L.
An exploratory flight investigation of helicopter
sling-load placements using a closed-circuit
television as a pilot aid
[NASA-TN-D-7776] N75-10009
- KELLY, J. D.
Radio frequency heating of radomes in an
aerodynamic environment
A75-10876
- KHLUPNOV, A. I.
Applied aerodynamics
A75-13026
- KIMURA, H.
Measurement of pitching moment on an oscillating
rectangular wing at transonic speeds using the
resonance method
A75-12829
- KIRBY, D. A.
Low-speed wing-tunnel measurements of the lift,
drag and pitching moment of a series of cropped
delta wings
[ARC-R/M-3744] N75-10030
- KOCH, R. L.
Turbofan noise reduction using a near sonic inlet
[AIAA PAPER 74-1098] A75-10281
- KOEHLER, R.
Optimum transient response characteristic of a
VTOL aircraft with direct side force control
[DLR-FB-73-72] N75-10103
- KOENIG, D. G.
Comparison of the acoustic characteristics of
large-scale models of several propulsive-lift
concepts
[AIAA PAPER 74-1094] A75-10278
- KOLESNIKOV, K. S.
An elastic flight vehicle as an automatic control
plant
A75-12329
- KONIECZNY, J. P.
Radomes for high gain arrays
A75-10858
- KONSON, E. D.
Variational-difference method of studying the
stressed state of the rim of the turbine disk in
a T-shaped tail joint
A75-11235
- KOONCE, J. M.
Effects of ground-based aircraft simulator motion
conditions upon prediction of pilot proficiency,
part 1
[AD-783256] N75-10112
- KOOSINLIN, M. L.
Turbulent mean velocity measurements on a rotating
cone
A75-10043

- KORDZINSKI, W.
Viper turbojet engines. II
A75-11371
- KOSHEVOI, V. M.
Applied aerodynamics
A75-13026
- KOVALEV, V. A.
Preliminary test results of the 'oblique ray'
installation
A75-11641
- KOVASA, G. T.
Application of methods of abstract algebra to the
synthesis of an automatic system for controlling
the longitudinal motion of an aircraft
A75-11121
- KOZHEVNIKOV, I. V.
Optimization of automated static tests of gas
turbine engines
A75-12332
- KRASNER, L. M.
Fire protection of large Air Force hangars
[AD-784859] N75-10961
- KRASNOV, M. F.
Applied aerodynamics
A75-13026
- KRISHNANURTHY, V.
Potential flow past annular aerofoils
A75-12619
- KRY, P. R.
Aerodynamic torques on rotating oblate spheroids
A75-11151
- KRYTER, K. D.
Reliability of laboratory tests of VSTOL and other
long duration noises
[NASA-CR-2471] N75-10093
- KUHLBERG, J. F.
The digital electronic propulsion control system -
Problems and payoffs
[AIAA PAPER 74-1068] A75-10261
- L
- LAMBERT, M.
S-3A Viking - Carrier's shield
A75-13149
- LANDER, J. A.
Exhaust nozzle deflector systems for V/STOL
fighter aircraft
[AIAA PAPER 74-1169] A75-10320
- LANDGEBBE, A. J.
Measurement of model helicopter rotor flow
velocities with a laser Doppler velocimeter
A75-10839
- LAPORTE, R.
Generation of aerodynamic profiles and
establishing the circulation around a wing by
deformation of the wing
A75-12638
- LASSOTA, S.
Practical application of the Howard-Czencow method
- Calculation of bent and axially compressed
beams. II
A75-11375
- LATHAM, E. A.
Variable geometry for supersonic mixed-compression
inlets
[AIAA PAPER 74-1172] A75-10322
- LAVRENTIEV, I. U. A.
Influence of inherent carrier motion on a
frequency selection system.
A75-12060
- LAYTON, G. P.
NASA Flight Research Center scale F-15 remotely
piloted research vehicle program
N75-10912
- LAZARICK, R. T.
A test cell engine diagnostic system - From
research to reality
[AIAA PAPER 74-1207] A75-10349
- LENSKI, J. W., JR.
HLH/ATC engine shaft support bearing development
program
[AD-784593] N75-10097
- LESSEN, M.
The stability of a trailing line vortex. II -
Viscous theory
A75-10621

- LEWIS, W. H.
From creaking cracks to breaking beams - A review
of acoustic emission for aircraft structure
A75-13035
- LIEVENS, C.
Critical analyses and laboratory research work at
the stage of aircraft preliminary design
[NASA-TT-F-15996] N75-10055
- LINDEN, A. W.
The rotor systems research aircraft - A flying
wind tunnel
[AIAA PAPER 74-1277] A75-11114
- LINDEN, D. E.
FAA Advisory Circular 00-41 Quality System
Certification Program
A75-10675
- LINDERMAN, D. L.
Test and evaluation of a fighter aircraft
in-flight thrust reverser
[AIAA PAPER 74-1170] A75-10321
- LISS, A. IU.
Calculation of helicopter main rotor blade
deformation with account for control flexibility
A75-12087
- LIST, R.
Aerodynamic torques on rotating oblate spheroids
A75-11151
- LIU, C. H.
A computing method for sound propagation through a
nonuniform jet stream
[NASA-TM-X-71941] N75-10359
- LOBUE, N.
B-1 forward radome
A75-10866
- LOCKWOOD, P. C.
Turbulent mean velocity measurements on a rotating
cone
A75-10043
- LOEBERT, G.
Performance improvement through control configured
vehicle concept
[NASA-TT-F-15998] N75-10059
- LOGOTHETTI, T. J.
The use of hydrogen in commercial aircraft - An
assessment
A75-10542
- LOUISSE, J.
Prediction of ground effects for VTOL aircraft
with twin lifting jets
[AIAA PAPER 74-1167] A75-10318
- LOWDER, E. M.
Effective data monitoring during airplane flyover
noise tests
N75-10928
- LUDWIG, L. P.
Sealing technology for aircraft gas turbine engines
[AIAA PAPER 74-1188] A75-10336
- Mainshaft seals for small gas turbine engines
[ASLE PREPRINT 74LC-1C-2] A75-12197
- LUKAS, J. S.
Reliability of laboratory tests of VSTOL and other
long duration noises
[NASA-CR-2471] N75-10093
- LUMSDEN, R. B.
Automatic flying of curved approach paths: A
computer and flight investigation
[RAE-TR-73154] N75-10043
- LYNWANDER, P.
Mainshaft seals for small gas turbine engines
[ASLE PREPRINT 74LC-1C-2] A75-12197
- M**
- MACKENZIE, A.
Application of the fast Fourier transform to
ground vibration testing, and flight flutter
testing
N75-10926
- MACPHERSON, P. B.
A case study of ultra high rate of wear
experienced in a gear tooth flank
[ASLE PREPRINT 74LC-6B-2] A75-12188
- MALLOW, A.
Airborne testing of advanced multisensor aircraft
N75-10921
- MALONEY, P.
Elastic pitch beam tail rotor operational
suitability investigation
[AD-784595] N75-10069
- MANI, R.
Isolated rotor noise due to inlet distortion or
turbulence
[NASA-CR-2479] N75-10094
- MARCOM, D. C., JR.
A parametric study of effect of forebody shape on
flow angularity at Mach 8
[NASA-TN-D-7768] N75-10008
- MARSHALL, F. L.
Prediction of ground effects for VTOL aircraft
with twin lifting jets
[AIAA PAPER 74-1167] A75-10318
- MARTENS, R. E.
F-15 nozzle/afterbody integration
[AIAA PAPER 74-1100] A75-10283
- MATTES, R.
Real-time measuring procedure and measuring
equipment for recording the radiation patterns
of aircraft antennas in flight
[ESRO-TT-74] N75-10292
- MATTES, R. E.
High acceleration cockpits for advanced fighter
aircraft. Volume 2: Crew station
design/integration
[AD-783601] N75-10065
- MCANALLY, W. J., III
Small turbine engine technology
[AIAA PAPER 74-1184] A75-10333
- MCCLAREN, S. W.
Laminated metallic structure - Advanced applications
A75-13046
- MCEVILLY, A. J.
Lifetime prediction methods for elevated
temperature fatigue
N75-10493
- MCLAUGHLIN, R. J.
The development of an accurate aerodynamic
simulation model for the SAM-D missile with a
relatively small computer storage requirement
A75-10414
- MCLAUGHLIN, M. D.
Simulation studies of STOL airplane operations in
metropolitan downtown and airport air traffic
control environments
[NASA-TN-D-7740] N75-10038
- MELLINGER, B.
A critique of the F-14A air inlet control system -
From development to production status
[AIAA PAPER 74-1060] A75-11278
- MERIGOUX, J. M.
High-performance centrifugal compressors
A75-11739
- MESSENGER, H. E.
Two-stage fan. 2: Data and performance with
redesigned second stage rotor uniform and
distorted inlet flows
[NASA-CR-134710] N75-10944
- MIDDLETON, D. B.
Analysis of a flare-director concept for an
externally blown flap STOL aircraft
[NASA-TN-D-7760] N75-10061
- MIHAIL, A.
Reliability and maintainability of aircraft jet
engines. II
A75-12125
- MIKELADZE, V. G.
Fundamental geometric and aerodynamic
characteristics of aircraft and finned rockets
A75-11577
- MILLER, M. P.
Boron/aluminum for space applications
A75-13048
- MILLER, W. A.
Polycarbonate aircraft transparencies
A75-13041
- MITRYAEV, I. M.
Determination of the forces in the retractor of a
three-dimensional landing gear mechanism
[AD-784257] N75-10078
- MOOREFIELD, S. A.
Lightning protection for advanced aircraft radomes
based on the segmented lightning diverter strip
A75-10877
- B-1 forward radome fabrication
A75-10881

- MOORHOUSE, D. J.
Comment on 'Investigation of multi-element
airfoils with external flow jet flap' by P.
Mavriplis
A75-11084
- MORAN, M. S.
Statistical analysis of general aviation VG-VGH data
[NASA-CR-132531]
N75-10933
- MORRIS, G. J.
Operating experiences of retardant bombers during
firefighting operations
[NASA-TM-X-72622]
N75-10934
- Investigation and optimization of micro-oxidation
techniques employed in gas turbine engine oil
characterization.
[AD-784787]
N75-11359
- MOSSMAN, D. C.
Automated avionics system checkout and monitoring
in a flight test environment
N75-10920
- MOUILLE, R.
The SA. 360 'Dauphin' - Definition and development
A75-11722
- MOULDEN, T. H.
A flow field model for, and some studies on the
drag of, an engine exhaust system at transonic
flight speeds
[AIAA PAPER 74-1175]
A75-10325
- MUELLER, R. M.
Rationale for cost-weight analysis
[AIAA PAPER 74-961]
A75-13069
- MULKIDZHANOV, I. K.
Operational effectiveness of transport aircraft
[NASA-TT-P-810]
N75-10036
- MYERS, D. L.
Endurance testing of an LM-726-4 elastomeric pitch
change bearing
[AD-784140]
N75-10074

N

- NAKANURA, Y.
Pitch damping of helicopter rotor with nonuniform
inflow
A75-11094
- NATTER, H.
Performance limitation of a hypersonic ramjet
engine due to reaction kinetics
A75-11046
- NEATE, E. P.
The Detroit Diesel Allison Model 250-C28
turboshaft engine
[AIAA PAPER 74-1186]
A75-10335
- NEWIRTH, D. M.
The digital electronic propulsion control system -
Problems and payoffs
[AIAA PAPER 74-1068]
A75-10261
- NISS, G.
A Saab-Scania developed method for obtaining
stability derivatives from flight tests
N75-10925
- NUCHANOV, Z. KH.
Experimental study of spanwise air jet influence
on wing aerodynamic characteristics
A75-12096

O

- OEHMEN, K. H.
An extension of the 'parabolic method' to the
calculation of transonic flows
A75-10837
- OGREN, H.
Yaw axis stability augmentation system flight test
report
[AD-784134]
N75-10083
- OLLERHEAD, J. B.
A survey of aircraft noise annoyance in an area of
invariant noise to eliminate the effects on
annoyance of varying noise exposure
[TT-7405]
N75-10755
- OMELCHAK, A. I.
Variational-difference method of studying the
stressed state of the rim of the turbine disk in
a T-shaped tail joint
A75-11235
- OPREL, A.
Navigation in the use of helicopters offshore
A75-12373

- ORMISTON, R. A.
Hingeless rotorcraft flight dynamics
[AGARD-AG-197]
N75-10003
- Techniques for improving the stability of soft
inplane hingeless rotors
[NASA-TM-X-62390]
N75-10058
- ORTH, R. C.
Flow immediately behind a step in a supersonic
combustor
[AIAA PAPER 74-1161]
A75-10317
- OSECHKIN, V. V.
Atmospheric ozone and its influence on the
operation of supersonic transport
A75-11639

P

- PADULA, S. L.
A computing method for sound propagation through a
nonuniform jet stream
[NASA-TM-X-71941]
N75-10359
- PAILLET, F.
The stability of a trailing line vortex. II -
Viscous theory
A75-10622
- PALCZA, J. L.
Exhaust nozzle deflector systems for V/STOL
fighter aircraft
[AIAA PAPER 74-1169]
A75-10320
- PALKO, R. L.
Development and experimental verification of a
technique to test full-scale inlet/engine
systems at maneuvering conditions
[AIAA PAPER 74-1199]
A75-10344
- PARK, K. C.
Development and experimental verification of
procedures to determine nonlinear
load-deflection characteristics of helicopter
substructures subjected to crash forces. Volume
1: Development of simplified analytical
techniques to predict typical helicopter
airframe crushing characteristics and the
formulation of design procedures
[AD-784191]
N75-10944
- PAUL, O.
Weldability and quality of titanium alloy weldments
A75-13044
- PAVLOV, V. A.
Analysis of multihinge tailplane with account for
control surface deflection
A75-12088
- PAYAUYS, K. W.
Statistical analysis of general aviation VG-VGH data
[NASA-CR-132531]
N75-10933
- PEELER, D. J.
Reliability of laboratory tests of VSTOL and other
long duration noises
[NASA-CR-2471]
N75-10093
- PETRARCA, J., JR.
Lubricity of jet A-1 and JP-4 fuels
[AD-784772]
N75-11115
- PI, W. S.
Transonic buffet behavior of Northrop F-5A aircraft
[NASA-CR-140939]
N75-10054
- PISCOPO, P. F.
A test cell engine diagnostic system - From
research to reality
[AIAA PAPER 74-1207]
A75-10349
- POISSON-QUINTON, P.
Critical analyses and laboratory research work at
the stage of aircraft preliminary design
[NASA-TT-P-15996]
N75-10055
- POLIKARPOV, P. A.
Influence of swirling flow on heat transfer in
nozzles
A75-10204
- POLLMANN, E.
Applications of similarity laws in the case of
turbomachines
A75-11674
- POLYMSKIKH, M. V.
Effect of the rotation rate of the rotor on the
angular rigidity of the elastic suspension of a
Houze gyroscope
N75-11244
- POPOV, K.
Resistance of radar systems against interference
N75-11799

POTAPOVA, L. A.
Interference of a sweptback wing and the fuselage
at transonic speeds
[NASA-TT-P-15993] N75-10056

POWE, R. E.
A wind energy conversion system based on the
tracked-vehicle airfoil concept A75-10518

POWER, H. L.
Experimental hydraulic ram studies (FY 74)
[AD-784736] N75-11230

PRAYTOR, E. B.
Ground effect for V/STOL aircraft configurations
and its simulation in the wind tunnel. Part 3:
The tangentially blown ground as an alternative
to a moving ground: Application to the
NASA-Ames 40 by 80-foot wind tunnel
[NASA-CR-114497] N75-10005

PRIBYL, R. E.
A study of stabilization techniques for small,
fixed-wing, remotely piloted aircraft
[AD-784109] N75-10079

PROBERT, B.
A method of obtaining sub-critical compressible
velocities for two-dimensional aerofoils from an
exact inviscid incompressible solution A75-10189

PURINTON, D.
EM window thermal barriers A75-10857

Q

QUINN, T. J.
High acceleration cockpits for advanced fighter
aircraft. Volume 3: Test plan
[AD-783602] N75-10066

High acceleration cockpits for advanced fighter
aircraft. Volume 4: Test results
[AD-783603] N75-10067

R

RAWDALL, L. M.
Inlet development for the B-1 strategic bomber
[AIAA PAPER 74-1064] A75-10258

REED, D. H.
Scale model testing of the jet noise
characteristics of the JT8D refan engine nozzle
system
[NASA-CR-134618] N75-10091

REED, J. H.
The attainable goal in airline safety N75-10035

REESE, B. A.
Studies of slurry fueled propulsion systems
[AD-784362] N75-11114

REJSKE, J. V.
A test technique for inlet/aircraft drag evaluation.
[AIAA PAPER 74-1145] A75-10306

REUKAUF, P. J.
Flight-test techniques for obtaining valid
comparisons of wind-tunnel and flight results
from tests on a YF-12 mixed-compression inlet
[AIAA PAPER 74-1195] A75-11301

ROBERTS, J., JR.
High acceleration cockpits for advanced fighter
aircraft. Volume 2: Crew station
design/integration
[AD-783601] N75-10065

ROBERTSON, A. R.
Boron/aluminum for space applications A75-13048

RODEWALD, M.
Estimation of the characteristics of various flare
profiles
[ESRO-TT-89] N75-10031

ROGACHEV, G. V.
Calculation of the aerodynamic characteristics of
a system of rectangular wings moving near a
screening surface A75-12078

ROGOZIN, I. U. A.
Calculation of the aerodynamic characteristics of
a system of rectangular wings moving near a
screening surface A75-12078

ROLAND, H. E., JR.
A methodology for determining the flight system
mix of an air transfer route structure N75-10033

RUMPLER, E.
MBB BO 105. II - Concept and worldwide use A75-12525

RYAN, J. W.
The use of hydrogen in commercial aircraft - An
assessment A75-10542

RZEMEK, K.
Certain problems of fuel consumption in air
transport A75-11372

S

SACHS, G.
Stability limits for downsprings A75-12618

SALTER, G. R.
A computer program for aircraft thrust ejector
analyses
[AIAA PAPER 74-1191] A75-10339

SAND, W. R.
Development of an armored T-28 aircraft for
probing hailstorms A75-10638

SAWYER, R. H.
Simulation studies of STOL airplane operations in
metropolitan downtown and airport air traffic
control environments
[NASA-TN-D-7740] N75-10038

SCHLEUSENER, R. A.
Development of an armored T-28 aircraft for
probing hailstorms A75-10638

SCHWELL, W. C.
F-14A installed nozzle performance
[AIAA PAPER 74-1099] A75-10282

SCHOEN, J.
Vibrational investigations on aircraft models in
support of flutter calculations A75-11676

SCHWEIKHARD, W. G.
Flight-test techniques for obtaining valid
comparisons of wind-tunnel and flight results
from tests on a YF-12 mixed-compression inlet
[AIAA PAPER 74-1195] A75-11301

SCHWENKER, H.
MIL-H-83282, fire resistant hydraulic fluid A75-13052

SCHWOCH, H.
Steam rockets for takeoff A75-11373

SEGUIN, J. A. M.
Two dimensional transonic two-phase flow in
axisymmetric nozzles
[AIAA PAPER 74-1088] A75-10275

SEVERIN, T. P.
Statistical analysis of general aviation VG-VGH data
[NASA-CR-132531] N75-10933

SHAH, J. B.
Failure analyses of aircraft accidents. II A75-12726

SHCHUKIN, V. K.
Heat and mass transfer in engines of flight vehicles
A75-10203

Influence of swirling flow on heat transfer in
nozzles A75-10204

SHERSHUKOV, V. D.
Optimization of automated static tests of gas
turbine engines A75-12332

SHESTAKOV, V. Z.
Influence of airplane structural elasticity on
flight safety and comfort in turbulent atmosphere
A75-12098

SIGALOV, G. P.
Low-frequency three-dimensional profile vibrations
in transonic gas flow A75-13132

SIMON, J. Y.
Development of Slip Cast Fused Silica radomes
A75-10870

- SIMPER, J. I.**
Results of a series of wind tunnel tests on the victor B.Mk.2 aircraft and a comparison with drag estimates and full scale flight data [ARC-CP-1283] N75-10026
- SINNETT, J. M.**
High acceleration cockpits for advanced fighter aircraft. Volume 1: Program summary [AD-783600] N75-10064
- SMELTZER, D. B.**
Variable geometry for supersonic mixed-compression inlets [AIAA PAPER 74-1172] A75-10322
- SMIRNOV, M. M.**
Operational effectiveness of transport aircraft [NASA-TT-F-810] N75-10036
- SMITH, E. M.**
Precision in LCHTF testing N75-10490
- SMITH, P. D.**
A calculation method for the turbulent boundary layer on an infinite yawed wing in compressible, adiabatic flow [ARC-CP-1268] N75-10024
- SNYDER, C. E.**
MIL-H-83282, fire resistant hydraulic fluid A75-13052
- SOBIESZCZANSKI, J. E.**
On computer-aided design of aerospace vehicles A75-11626
- SOLAK, J. B.**
Technology development report: Results of static electricity discharge system tests (active and passive) heavy lift helicopter [AD-784130] N75-10082
- SOLOMIN, S. V.**
Atmospheric ozone and its influence on the operation of supersonic transport A75-11639
- SOMJU, O. K.**
Development of explosively driven MHD generator for short pulse aircraft high power. Part 1: Analytical studies. Part 2: Experimental studies. Part 3: Design studies [AD-784903] N75-11764
- SORENSEN, M. E.**
Variable geometry for supersonic mixed-compression inlets [AIAA PAPER 74-1172] A75-10322
- SOTANSKI, D.**
Yaw axis stability augmentation system flight test report [AD-784134] N75-10083
- SPANGLER, R. M.**
Developing STOL operational criteria N75-10911
- SPARLING, R. C.**
B-1 forward radome A75-10866
- SPENGLER, G.**
Investigation and optimization of micro-oxidation techniques employed in gas turbine engine oil characterization [AD-784787] N75-11359
- SPIRKIN, V. G.**
The use of jet fuels in aviation A75-13000
- SPRING, D. J.**
A flow field model for, and some studies on the drag of, an engine exhaust system at transonic flight speeds [AIAA PAPER 74-1175] A75-10325
- STARIEJ, W.**
Loadings and flight limitations of the sailplane having the speed flap. I A75-10721
- STAHMANN, J. R.**
Lightning protection for advanced aircraft radomes based on the segmented lightning diverter strip A75-10877
- STALEY, J. T.**
Evaluating new aluminum forging alloys A75-12729
- STARK, V. J. E.**
Application of the polar coordinate method to oscillating wing configurations [SAAB-TN-69] N75-10010
- STASZEK, J.**
Some problems of the canard configuration. I A75-12473
- STAVA, D.**
A test technique for inlet/aircraft drag evaluation [AIAA PAPER 74-1145] A75-10306
- STEELE, R.**
A critique of the F-14A air inlet control system - From development to production status [AIAA PAPER 74-1060] A75-11278
- STIEL, W.**
Number of bars and torque of squirrel cage rotors [RAE-LIB-TRANS-1781] N75-11154
- STOPPEL, S. W.**
NASA-Langley helicopter tower instrumentation systems [NASA-CR-132522] N75-10106
- STONE, J. R.**
Noise of model target type thrust reversers for engine-over-the-wing applications [NASA-TM-X-71621] N75-10948
- STRATTON, A.**
Safety and air navigation A75-12372
- STREHLOW, R. A.**
Agenda and abstracts 1974 AFOSR contractors meeting on Unconfined Detonation and Fuel-Air Explosion Related Research [AD-783253] N75-11117
- STREIB, R. A.**
V/STOL deflector concepts [AIAA PAPER 74-1168] A75-10319
- STRIBPP, H. G.**
Ejector thrust augmentation for STOL aircraft applications [AIAA PAPER 74-1192] A75-10340
- STRICOFF, R. S.**
Evaluation of auxiliary agents and systems for aircraft ground fire suppression, phase 2 [AD-784924] N75-10957
- STROUD, W. J.**
Automated structural design with aeroelastic constraints - A review and assessment of the state of the art A75-11624
- STYRON, J. B.**
B-1 forward radome fabrication A75-10881
- SUBRAMANIAN, M. R.**
Potential flow past annular aerofoils A75-12619
- SUIT, W. T.**
Extraction from flight data of lateral aerodynamic coefficients for F-8 aircraft with supercritical wing [NASA-TN-D-7749] N75-10006
- SUKHOV, V.**
An elastic flight vehicle as an automatic control plant A75-12329
- SWAN, W. M.**
A policy study of subsidized air service [AIAA PAPER 74-1274] A75-11111
- SWAVELY, C. E.**
Engine flow diverter system for the XPV-12A prototype aircraft [AIAA PAPER 74-1194] A75-10341
- SZUCH, J. R.**
Real-time simulation of the TF30-P-3 turbofan engine using a hybrid computer [NASA-TM-X-3106] N75-10095
- SZUSTER, K.**
Selected problems concerning the strength of a bonded heavily loaded Dural structure A75-12475
- T**
- TALLEY, M. E.**
Rationale for cost-weight analysis [AIAA PAPER 74-961] A75-13069
- TEIPEL, I.**
An extension of the 'parabolic method' to the calculation of transonic flows A75-10837

- TENO, J.**
Development of explosively driven MHD generator for short pulse aircraft high power. Part 1: Analytical studies. Part 2: Experimental studies. Part 3: Design studies
[AD-784903] N75-11764
- THOMPSON, A. J.**
Polyimide materials development for high temperature, broadband radome applications
A75-10872
- THOMSON, C.**
A critique of the F-14A air inlet control system - From development to production status
[AIAA PAPER 74-1060] A75-11278
- TITOV, V. H.**
Fundamental geometric and aerodynamic characteristics of aircraft and finned rockets
A75-11577
- TOWNES, H. W.**
A wind energy conversion system based on the tracked-vehicle airfoil concept
A75-10518
- TRAICHE, C. W.**
Uses of a visual landing system in primary flight training
[AD-784888] N75-10960
- TYLER, R. A.**
Experience with the NRC 10 feet by 20 feet V/STOL propulsion tunnel: Some practical aspects of V/STOL engine model testing
[DME/NAE-1973(2)] N75-10107
- TYUNIN, N. H.**
A study of the damping characteristics on models of supersonic air lines at supersonic speeds
[AD-784259] N75-10077
- U**
- UDILOV, V. V.**
Application of methods of abstract algebra to the synthesis of an automatic system for controlling the longitudinal motion of an aircraft
A75-11121
- URLING, H. R.**
Automated avionics system checkout and monitoring in a flight test environment
N75-10920
- USAB, W. J.**
V/STOL deflector concepts
[AIAA PAPER 74-1168] A75-10319
- USHAKOV, M. V.**
A study of the damping characteristics on models of supersonic air lines at supersonic speeds
[AD-784259] N75-10077
- V**
- VAN DER HARTEN, R. J.**
Navigation in the use of helicopters offshore
A75-12373
- VICKERS, T. K.**
ATC implications of the 747 SP
A75-11092
- VIETS, H.**
Oscillating jet nozzles for V/STOL application
[AIAA PAPER 74-1189] A75-10337
- VITTEK, J. P., JR.**
LTA in the USA - Here's where it stands today
[AIAA PAPER 74-1280] A75-11116
- VOIGT, S. J.**
On computer-aided design of aerospace vehicles
A75-11626
- W**
- WANNER, J. C.**
The CCV concept and specifications
[NASA-TT-F-15997] N75-10060
- WARD, V. G.**
Acoustics of the sonic boom
A75-13023
- WAUGH, J. S.**
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A75-10875
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A75-10542
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A75-12622
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[AIAA PAPER 74-1065] A75-11280
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N75-10494
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N75-10921
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N75-10012
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A75-11427
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[AD-784189] N75-10081
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Aircraft-velocity measurement through radar-altimeter echo with noncoherent detection
[SLA-74-112] N75-10290
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[NASA-TN-D-7749] N75-10006
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[AIAA PAPER 74-1275] A75-11112
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[DME/NAE-1973(2)] N75-10107
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[AD-784130] N75-10082
- WINTER, F. J., JR.**
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N75-10917
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A75-13044
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[AD-784191] N75-10940

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Helicopter dropsight
[AD-784551] N75-10084
- WOLOWICZ, C. H.
Experimental determination of airplane mass and
inertial characteristics
[NASA-TR-R-433] N75-10062
- WONG, W. F.
The application of boundary layer suction to
suppress strong shock-induced separation in
supersonic inlets
[AIAA PAPER 74-1063] A75-10257
- WOODWARD, F. A.
A viscous/potential flow interaction analysis
method for multi-element infinite swept wings,
volume 1
[NASA-CR-2476] N75-10358
- WU, J. H.
A flow field model for, and some studies on the
drag of, an engine exhaust system at transonic
flight speeds
[AIAA PAPER 74-1175] A75-10325
- WUSATOWSKI, T.
Kasprzyk's revelatory wing
A75-12474
- WYNOSKY, T. A.
V/STOL deflector concepts
[AIAA PAPER 74-1168] A75-10319

Y

- YAPFEE, E. L.
Teledyne aims at low-cost engines
A75-12722
- YANCEY, B. B.
Experimental determination of airplane mass and
inertial characteristics
[NASA-TR-R-433] N75-10062
- YEE, B. G. W.
A computer automated ultrasonic inspection system
for aircraft forgings
A75-12933
- YEGHAMARAYAN, K.
Pressure distribution on two wings with curved
leading edges at supersonic speeds
[ARC-R/M-3741] N75-10028
- YEGORSHEVA, N. I.
Tabulated values of combinations of cyclic and
hyperbolic functions
N75-10052
- YENNI, K. R.
An exploratory flight investigation of helicopter
sling-load placements using a closed-circuit
television as a pilot aid
[NASA-TN-D-7776] N75-10009
- YOUNG, L. L.
Uses of a visual landing system in primary flight
training
[AD-784888] N75-10960

Z

- ZAKHARCHENKO, V. P.
Applied aerodynamics
A75-13026
- ZIPFEL, P. H.
Aerodynamic symmetry of aircraft and guided missiles
[AD-784254] N75-10070

CONTRACT NUMBER INDEX

AERONAUTICAL ENGINEERING /A Special Bibliography (Suppl. 54)

FEBRUARY 1975

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AF PROJ. 683K	N75-10961	DAAJ02-73-C-0023	N75-10073
AF PROJ. 683N	N75-10958	DAAJ02-73-C-0051	N75-10940
	N75-10959	FTD PROJ. T74-01-12	N75-10077
AF PROJ. 1369	N75-10078	F29601-73-C-0043	N75-10961
AF PROJ. 3048	N75-11115	F29601-74-C-0030	N75-10959
AF PROJ. 3145	N75-11764	F33615-69-C-1644	N75-12729
AF PROJ. 6190	N75-10064	F33615-71-C-1380	N75-10877
	N75-10065	F33615-71-C-1694	N75-10859
	N75-10066	F33615-72-C-1395	N75-11764
	N75-10067	F33615-72-C-1460	N75-13048
AF PROJ. 7343	N75-11359	F33615-72-C-1580	N75-10324
AF PROJ. 9711	N75-11117	F33615-72-C-1624	N75-13044
AF PROJ. 9778	N75-10112	F33615-72-C-1828	N75-12933
	N75-10960	F33615-72-C-2039	N75-13044
AF PROJECT 7381	A75-13044	F33615-73-C-1156	N75-10071
AF-AFOSR-74-2712	A75-12622	F33615-73-C-3067	N75-10064
AF-AFOSR-2524-73	N75-11117		N75-10065
AT (29-1)-789	N75-10290		N75-10066
DA PROJ. 1F1-62203-A-119	N75-10073		N75-10067
DA PROJ. 1F1-62205-A-119	N75-10080	F33615-74-C-5151	N75-13048
DA PROJ. 1F1-62205-AH-88	N75-10940	F33657-70-C-0800	N75-10881
DA PROJ. 1F1-62208-AA-82	N75-10075	F33657-72-C-0422	N75-10957
DA PROJ. 1F1-63204-DB-38	N75-10074	F33657-72-C-0702	N75-11279
DA PROJ. 1F1-63205-DB-38	N75-10081	F33657-72-C-0706	N75-13047
DA PROJ. 1F2-62203-AH-86	N75-10069	F44620-70-C-0105	N75-10112
DA PROJ. 1T1-61101-A-91A	N75-10046		N75-10960
DA PROJ. 67372512-K-2101	N75-10079	MIN-TEC-KC-49/25/CB/5/D	N75-10026
DAAH01-74-C-0183	A75-10325	NAS-2481	N75-10060
DAAJ01-71-C-0840	N75-10063	NASW-2481	N75-10055
	N75-10082		N75-10056
	N75-10097		N75-10059
DAAJ02-71-C-0063	N75-10069	NASW-2483	N75-10036
DAAJ02-71-D-0001	N75-10080	NAS1-11602	N75-10093
DAAJ02-72-C-0091	N75-10074	NAS1-12389	N75-10933
DAAJ02-72-C-0105	N75-10075	NAS1-12841	N75-10106
DAAJ02-72-C-0111	N75-10083	NAS2-6475	N75-10054
DAAJ02-72-C-0114	N75-10081	NAS2-6690	N75-10005
		NAS2-7048	N75-10358
		NAS2-7208	N75-10941
		NAS2-7732	N75-10943
		NAS3-11158	N75-10947
		NAS3-13494	N75-10944

NAS3-16720	A75-12197
NAS3-17842	N75-10091
NAS3-17853	N75-10094
NAS8-27738	A75-13048
NGR-22-009-571	N75-10937
NGR-33-016-177	N75-10088
NSF AG-398	N75-10039
NSF C-460	A75-10638
NSF GI-39415	A75-10518
NSG-2016	A75-12622
N00017-72-C-4401	A75-10317
SN/1170/012	N75-10755
W-7405-ENG-26	N75-10039
501-06-05	N75-10062
501-22-04-01	N75-10007
501-24	N75-10095
501-26-04-02	N75-10006
504-29-14-01	N75-10061
505-03-12-02	N75-10359
505-08-20-01	N75-10934
505-10-22	N75-10057
760-63-04-03	N75-10009
760-66-01-02	N75-10008
760-67-05	N75-10936
768-81-04-01	N75-10038

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